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Interim Hanford Waste Management Technology Plan

Date Published: September 1985

Prepared for the U.S. Department of Energy
under Contract DE-AC06-77RL01030

The contents of this report are preliminary until a record-of-decision has been received from the forthcoming Hanford Defense Waste--Environmental Impact Statement.

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Technical Issue SST-1

INTERIM MANAGEMENT

Statement of Issue

The technical issue is: What, if any, additional technology is required to continue safe interim storage of wastes in single-shell tanks and what work must be performed to provide the new technology?

Development of the technology to assure continued safe interim storage (i.e., prior to final disposal) of wastes in single-shell tanks (SSTs) is the concern of this technical issue. Proper priority needs to be given to timely acquisition of whatever technical improvements are needed to assure continued protection of personnel and the environment during the interim storage period.

Scope

Operation of single-shell tank farms has shifted from active management of liquid wastes to management of an isolated, solidified material (ERDA, 1975). Implementation of updated surveillance technology has been initiated (e.g., liquid observation well monitoring). Ongoing technology support needed for continued interim management of SSTs must be provided prior to final disposal at the tanks.

Status

Significant interim management technology has recently been developed and/or implemented. The structural integrity of single-shell waste tanks for continued storage has been evaluated (DeFigh-Price and Dahlke, 1983). Surveillance has been improved by the development of liquid observation wells and dry wells. Fifty-nine in-tank liquid observation wells are being installed and activated and 11 more are scheduled for installation.

Process tests to evaluate breathing filters as a method for ventilating stabilized and isolated single-shell tanks are ongoing.

Design of a configuration control system for waste tanks which includes accurate records of design location and condition of waste storage facilities has been completed.

Ventilation requirements for single-shell tanks were reviewed in FY 1984, and necessary upgrades were identified.

A thorough review of literature related to the safety and stability of ferrocyanide compounds such as those present in some Hanford single-shell tanks was conducted in FY 1984. It was concluded that the potential for exothermic reactions is very low; thus, no recognized safety hazards are posed.

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Tasks to Close the Issue

The following tasks close the issue of interim management of SST wastes:

SST-1.1 Provide ongoing technology support for interim management

Provide ongoing technology support as needed to establish continued interim management of SST wastes. Changes to the existing surveillance methods will be justified by a technical basis. This task includes appropriate studies and analyses of the number of monitoring systems, their location, and frequency of measurements to achieve a program level of statistical confidence in monitoring results. ($300,000)

SST-1.2 Update SST configuration control (Completed)

Complete the design of a configuration control system which includes accurate records of design, location, and condition of SSTs. Update as necessary. (Completed in FY 1984)

SST-1.3 Review SST ventilation requirements (Completed)

Review ventilation requirements for SSTs and determine if upgrades are required. (Completed in FY 1984)

SST-1.4 Update candidate ventilation systems (Completed)

Screen, test, and select candidate updated ventilation systems. (Completed in FY 1984)

SST-1.5 Establish monitoring and sampling requirements (Completed)

Establish the level of sensitivity and accuracy of monitoring and sampling measurement systems. Determine if systems should be modified. (Completed in FY 1984)

SST-1.6 Test and update candidate monitoring and sampling system (Completed)

Screen, test, and select candidate modified monitoring and sampling system. (Completed in FY 1984)

SST-1.7 Evaluate potential for exothermic reactions (Completed)

Conduct appropriate literature reviews and laboratory studies to determine the potential for exothermic reactions in SSTs containing nickel ferrocyanide solids. (Completed in FY 1984)

SST-1.8 Define methods to mitigate exothermic reactions (Completed)

Define appropriate methods to eliminate or mitigate exothermic reactions. (Completed in FY 1984)

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Interim Hanford Waste Management Technology Plan

Defense Waste Management

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Printed in the United States of America

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EXECUTIVE SUMMARY

The Interim Hanford Waste Management Technology Plan (HWMTP) is a companion document to the Interim Hanford Waste Management Plan (HWMP). A reference plan for management and disposal of all existing and certain projected future radioactive Hanford Site Defense Wastes (HSDW) is described and discussed in the HWMP. Implementation of the reference plan requires that various open technical issues be satisfactorily resolved. The principal purpose of the HWMTP is to present detailed descriptions of the technology which must be developed to close each of the technical issues associated with the reference plan identified in the HWMP. If alternative plans are followed, however, technology development efforts including costs and schedules must be changed accordingly.

Technical issues addressed in the HWMTP and HWMP are those which relate to disposal of single-shell tank wastes, contaminated soil sites, solid waste burial sites, double-shell tank wastes, encapsulated $^{137}CsCl$ and $^{90}SrF_2$, stored and new solid transuranic (TRU) wastes, and miscellaneous wastes such as contaminated sodium metal. Among the high priority issues to be resolved are characterization of various wastes including early determination of the TRU content of future cladding removal wastes; completion of development of vitrification (Hanford Waste Vitrification Plant) and grout technology; control of subsidence in buried waste sites; and development of criteria and standards including performance assessments of systems proposed for disposal of HSDW. The detailed discussion of each technical issue includes a flow diagram which graphically illustrates how completion of all or, in some cases, only part of the listed tasks will resolve the issue in an orderly and rational manner. The flow diagrams demonstrate that resolution of all technical issues for a particular type of HSDW will provide a satisfactory technological basis for implementation of the reference disposal plan.

Schedules for resolving all identified open issues are presented in the HWMTP. These schedules, which are consistent with significant program dates noted in the HWMP, provide for closure of over 90 percent of all technical issues by 1991.

The estimated total cost (without provision for contingency) to close all identified technical issues is $315 million*. About 47 percent ($148 million) of this cost relates to resolution of issues involved in disposal of existing and future double-shell tank wastes. Resolution of issues associated with disposal of wastes in single-shell tanks is estimated

*This figure reflects costs for FY 1985 and FY 1986 in 1985 and 1986 dollars, respectively, and costs for FY 1987 and out years in FY 1987 dollars.

to cost \$40 million. Resolution of issues involved with disposal of solid stored and new TRU wastes is estimated to cost \$37 million. Development of criteria and standards, including necessary performance assessments for disposal of all HSDW, is estimated to cost \$21 million.

Estimates of the technology costs shown in this report are made on the basis that all identified tasks for all issues associated with the reference disposal plan must be performed. Elimination of, consolidation of, or reduction in the scope of individual tasks will, of course, be reflected in corresponding reduction of overall technology costs.

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INTERIM HANFORD WASTE MANAGEMENT TECHNOLOGY PLAN

I. INTRODUCTION

A. OBJECTIVES

The purpose of the Interim Hanford Waste Management Technology Plan (HWMTP) is to describe the technology needed to implement the reference plan presented in the Interim Hanford Waste Management Plan (HWMP*) for management and disposal of all existing and certain future radioactive defense wastes at the U.S. Department of Energy Hanford Site. Schedules and estimated costs for development of the needed technology elements are also presented in this document. The contents of this report are preliminary until a record-of-decision has been established from the forthcoming Hanford Defense Waste Environmental Impact Statement.

B. SCOPE

The HWMTP addresses the development and application of technology required for management and disposal of all existing and certain future radioactive Hanford Site Defense Wastes (HSDW) (Table I-1). Closely tied to the HWMP, the HWMTP identifies and amplifies open technical issues† and, for each such issue, defines the tasks†† which must be completed to satisfactorily close it. In all cases individual tasks which relate to a particular issue specify needed engineering studies and evaluations, as well as appropriate bench-, pilot plant-, and, in some cases, field-scale confirmatory experiments and tests. Detailed descriptions of all the individual tasks are not, however, included in this report; such detail is outside the scope of the HWMTP and is more properly the subject of specific task planning documents.

The detailed discussion of each technical issue in the HWMTP includes a flow diagram which graphically illustrates how completion of all, or in some cases, only part of the listed tasks will logically resolve the issue. In addition to presenting an orderly and rational sequence for performing studies, analyses, tests, etc., these flow diagrams also provide a convenient way of demonstrating that all the relevant tasks needed to close issues

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*Interim Hanford Waste Management Plan, September, 1985, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

†For purposes of the HWMTP, issues are broadly defined to be those particular technical questions and/or uncertainties which are of such significance that they must be answered or resolved before specific waste disposal plans in the HWMP can be satisfactorily implemented.

††A task is an element of work (e.g., engineering study, etc.) which must be completed as part of the process of resolving technical issues.

TABLE I-1. List of Hanford Site Defense Wastes Addressed in the Interim Hanford Waste Management Plan and the Interim Hanford Waste Management Technology Plan.[a]

Type	Acronym
Single-Shell Tank Wastes	SST
Contaminated Soil Sites	CSS
Solid Waste Burial Sites	SWB
Double-Shell Tank Wastes[b]	DST
Capsules (of $^{137}CsCl$ and $^{90}SrF_2$)	CAP
Stored and New TRU Solid Wastes	TRU
Miscellaneous Wastes[c]	MSC

[a]See Appendix A (Glossary) for further description of these waste types.

[b]Includes:
Neutralized Cladding Removal Waste (NCRW)
Neutralized Current Acid Waste (NCAW)
Double-Shell Slurry (DSS)
Double-Shell Slurry Feed
Complexed Concentrate (CC)
Hanford Facility Waste (HFW)
Neutralized Plutonium Finishing Plant (PFP) Waste

[c]Includes radioactively contaminated sodium metal and organic solvents.

have been identified. Key technical decisions are highlighted in some of the individual issue flow diagrams; such decisions are those which significantly impact the extent and cost of efforts needed to close a particular issue.

Overall costs based upon currently available estimates of required manpower, material, and equipment are presented to resolve all identified technical issues. Schedules for resolving all open technical issues are also presented; these schedules reflect and are in agreement with the major Hanford Site waste management milestones noted in the HWMP.

Technical issues described and discussed in this HWMTP relate primarily to the reference waste management and disposal plan presented in the HWMP. However, if alternative plans are followed, technical issues, including costs and schedules, will change accordingly.

C. ORGANIZATION

A listing of all the open technical issues considered in the HWMTP is provided in Section II. Also presented in Section II is a compilation of all key technical decisions which must be made to resolve the technical issues. Estimated annual costs (expense and equipment) to resolve all technical issues in the period 1985 through 2015, are summarized in Section III.*

The main part of the HWMTP (Section IV-XIII) is devoted to a detailed description of each technical issue and of the tasks which must be completed to resolve it. This part of the HWMTP is organized to address all technical issues related to disposal of the various kinds of HSDW (see Table I-1) as well as those issues involved in providing adequate Disposal Criteria and Standards, needed Performance Assessments, and an Enhanced Technology Base. Each technical issue is discussed in a standard format†, including a flow diagram which illustrates how completion of all or, in some cases, only part of the listed tasks will logically close the issue.

Schedules for closing all issues are included in Sections IV-XIII. Estimated costs of resolving all of the issues are also presented in Sections IV-XIII.

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*For Sections III-XIII of the HWMTP costs for FY 1985 and 1986 are shown as 1985 and 1986 dollars, respectively, while costs for FY 1987 and out years are shown as FY 1987 dollars.

†Described in Section II.

D. PERIODIC REVISIONS

As necessary, the HWMTP will be revised and updated annually to reflect any changes in schedules and costs for the resolution of technical issues. Such revisions will provide an opportunity to delete or add tasks and to review and update flow diagrams.

E. MAJOR CHANGES FROM PREVIOUS EDITION

This section of the report is new with this edition. It is included to alert readers to major changes in HWMTP contents and arrangements, and to state briefly reasons for the changes.

The September 1985 edition of the HWMTP has been changed from the December 1984 edition in the following ways:

- Relocation of interim waste management technical issues (SST-1, DST-2, and CSS-1) to Appendix B. This change was made because, in contrast to all other technical issues, the interim waste management technical issues do not relate directly to final disposal of the HSDW. Also, funding to close the interim waste management issues derives from sources other than those which support closure of most other issues. For these reasons, the SST-1, DST-2, and CSS-1 technical issues are conveniently placed in an appendix to the main text.

- Update and modification of reference plan for disposal of PFP aqueous waste. The reference plan for disposal of acidic, aqueous PFP waste stated in the December 1984 edition of the HWMTP calls for neutralization of the waste, interim storage of the TRU-containing sludge in double-shell tanks, retrieval of the sludge, pretreatment washing, and vitrification. In this edition, the reference plan has been changed to show treatment of the acid PFP waste stream (starting in 1989) to make it a non-TRU waste and to recover economically valuable plutonium; PFP sludges generated prior to 1989 will still, according to the reference plan, be retrieved, washed, and vitrified. Alternatively, these sludges may be dissolved in acid and treated to make them a non-TRU waste. Development of technology for recovery of TRU components from PFP waste is described in a new Technical Issue, DST-8.

- Revision of Technical Issue DST-6 (Immobilization of Glass) and TRU-4 (Stored Waste Processing--CH Waste). These issues were rewritten extensively so they conform closely to detailed technology program plans.

- Expansion of the scope of Technical Issue DCS-2 (Technical Baseline). The scope of this issue was expanded to include provisions for integrated planning as a basis for technology development and budgeting. This technical issue has been retitled, "Systems Integration and Planning."

- Change of scope of Technical Issue DCS-8 (Safety, Environmental, and External Affairs). Tasks that relate to external affairs activities are no longer included in the scope of this issue. This Technical Issue has been retitled "Safety and Environment."

- Deletion of Technical Issue TOA-1 (Technology for Other Alternatives). This technical issue provided a focal point to address development of new or modified technology that would be required if revisions were made to the reference plan. In future editions of the HWMTP any new or modified technology will be addressed, as required, in the appropriate individual technical issues (e.g., SST-2, DST-3, etc.).

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II. TECHNICAL ISSUES: INDEX AND FORMAT

A. TECHNICAL ISSUES FOR REFERENCE PLAN

The open technical issues associated with the reference plan identified in the HWMP for disposal of the HSDW are compiled in Tables II-1 through II-9. Issues involved in development of criteria and standards for disposal of the HSDW are listed in Table II-1. Issues involved in management and disposal of specific kinds of HSDW are listed in Tables II-2 through II-9.

Classification (by waste type), issue titles, and the order of listing of technical issues in Tables II-1 through II-9 are the same as in the HWMP. Each issue is assigned an alphanumeric identification symbol to facilitate further discussion; text pages in the HWMTP, where an extended description of each technical issue is provided, are also noted in Tables II-1 through II-9.

B. ISSUE FORMAT

For comparison purposes and to facilitate understanding, each issue is discussed in a standard format. Parts and functions of this format are listed below:

Issue Title/ Identification Symbol	-	Identifies waste type and particular technical issue addressed--tied to Tables II-1 through II-9.
Statement of Issue	-	Specifies what the issue is and indicates its origin and importance.
Scope	-	Provides background information (including references) on the nature and relevance of the technical issue, and indicates the type and breadth of work needed to resolve it.
Status	-	Summarizes the current state of knowledge of various facets of the issue, including significant details of any previous or ongoing laboratory tests and engineering studies.
Tasks to Close the Issue	-	Lists specific engineering studies and bench-, cold pilot plant-, and plant-scale tests and demonstrations to close the issue. An estimate of the costs of the effort to complete each task is provided.
Flow Diagram (for Issue Closure)	-	A schematic diagram which illustrates how completion of all, or in some cases, only part of the listed tasks will logically close the issue.

All the individual technical issue flow diagrams have been prepared in a standard format (Figure II-1). Explanatory comments on the various numbered parts of this form are provided in Table II-10.

<u>Key Technical Decisions</u> - Those decisions which significantly impact the extent and cost of efforts needed to close the technical issue.

TABLE II-1. Technical Issues--Disposal Criteria and Standards.

Issue identification number	Issue title	Issue discussion (pp)
DCS-1	Performance Assessments	IV-5
DCS-2	Systems Integration and Planning	IV-13
DCS-3	Single-Shell Tank Wastes	IV-17
DCS-4	Contaminated Soil and Solid Waste Burial Sites	IV-23
DCS-5	Double-Shell Tank Wastes	IV-29
DCS-6	Capsules	IV-35
DCS-7	Miscellaneous and Solid TRU Wastes	IV-39
DCS-8	Safety and Environment	IV-43

NOTE: Refer to the discussion on page IV-1 for definitions of the terms "criteria" and "standards" and for background material on the origin and importance of these issues.

TABLE II-2. Technical Issues--Disposal of Single-Shell Tank Wastes.

Issue identification number	Issue title	Issue discussion (pp)
SST-1	Interim Management	B-1
SST-2	Characterization	V-9
SST-3	Heat Management	V-15
SST-4	Complexant Effects	V-19
SST-5	Moisture Effects	V-23
SST-6	Dome Fill	V-27
SST-7	Protective Barriers	V-31
SST-8	Markers	V-37

TABLE II-3. Technical Issues--Disposal of Contaminated Soil Sites.

Issue identification number	Issue title	Issue discussion (pp)
CSS-1	Interim Management	B-6
CSS-2	Characterization	VI-9
CSS-3	Contaminated Soil Site Subsidence Control	VI-15
CSS-4	TRU Waste Immobilization	VI-19
CSS-5	Protective Barriers	VI-23
CSS-6	Markers	VI-25

TABLE II-4. Technical Issues--Disposal of Solid Waste Burial Sites.

Issue identification number	Issue title	Issue discussion (pp)
SWB-1	Characterization	VII-7
SWB-2	Subsidence Control	VII-13
SWB-3	TRU Waste Immobilization	VII-17
SWB-4	Protective Barriers	VII-21
SWB-5	Markers	VII-23

TABLE II-5. Technical Issues--Disposal of Double-Shell Tank Wastes.

Issue identification number	Issue title	Issue discussion (pp)
DST-1	Cladding Removal Waste TRU Content/Removal	VIII-7
DST-2	Interim Management	B-11
DST-3	Characterization	VIII-15
DST-4	Retrieval	VIII-19
DST-5	Feed Preparation	VIII-25
DST-6	Immobilization (Glass)	VIII-33
DST-7	Immobilization (Grout)	VIII-41
DST-8	TRU Removal from Aqueous PFP Waste	VIII-47

TABLE II-6. Technical Issues--Disposal of Capsules.

Issue identification number	Issue title	Issue discussion (pp)
CAP-1	Capsule Corrosion	IX-7
CAP-2	Geologic Disposal	IX-11

TABLE II-7. Technical Issues--Disposal of Stored and New TRU Solid Wastes.

Issue identification number	Issue title	Issue discussion (pp)
TRU-1	Assay and Nondestructive Examination	X-7
TRU-2	Surface Interim Storage	X-13
TRU-3	Stored Waste Retrieval--CH Waste	X-17
TRU-4	Stored Waste Processing--CH Waste	X-21
TRU-5	Remote Handled Waste	X-27
TRU-6	Waste Packaging and Transportation	X-33

NOTE: CH--Contact Handled.

TABLE II-8. Technical Issues--Disposal of Miscellaneous Wastes.

Issue identification number	Issue title	Issue discussion (pp)
MSC-1	Liquid Organic Wastes	XI-5
MSC-2	Contaminated Sodium Metal	XI-9

TABLE II-9. Technical Issues--Enhanced Technology Base.

Issue identification number	Issue title	Issue discussion (pp)
ETB-1	Potential Future Wastes--Technology Needs	XII-5
ETB-2	TRU Removal Technology	XII-9
ETB-3	Simplified ^{90}Sr Removal Technology	XII-13

NOTE: Refer to the discussion on page XII-1 for backup and material on the origin and importance of these ETB issues.

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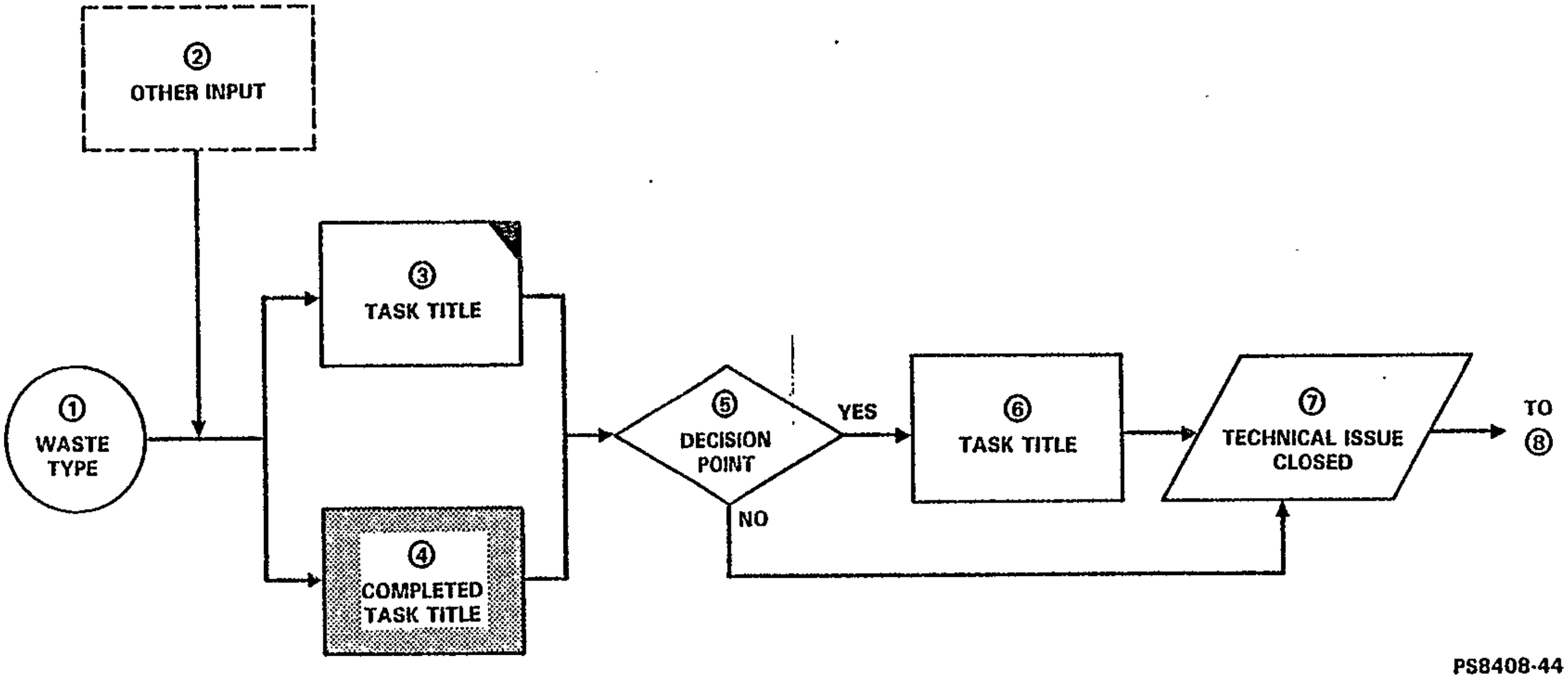

FIGURE II-1. Standard Format for Issue Closure Flow Diagrams.

TABLE II-10. Key to Symbols in Flow Diagram Format.

Number in Figure 1	Explanation
1	• Circles denote the particular type of Hanford waste addressed[a].
2	• Dotted rectangles denote input data or standards and criteria.
3, 4, 6	• Solid rectangles denote individual tasks.
	• Task titles are identical to those in the issue write-up.
	• A shaded area in the upper right corner of a solid rectangle indicates that work is presently in progress.
	• Hatched areas in a solid rectangle indicate that the task has been completed (e.g., 4)
	• A parallel arrangement of solid rectangles (e.g., 3 and 4) indicates tasks which can be performed concurrently.
5	• A diamond indicates a decision point stated in the form of a question which requires either a "yes" or "no" answer.
6	• Depending upon the answers to certain decision point questions (i.e., key technical decisions), some tasks (and associated manpower costs) may not be required to close the technical issue. For example, in Figure 1, Task 6 is not required for a "no" answer to the decision point in the diamond labeled 5.
7	• Parallelograms denote satisfactory closure of the particular technical issue.
8	• A terminal arrow indicates input to implementation of a reference disposal plan.

[a]Flow Diagrams for Technical Issues DCS-1, DCS-2, DCS-8, ETB-1, ETB-2, and ETB-3 which do not relate to a specific type of waste do not contain circles.

III. COST SUMMARY

A. ISSUE RESOLUTION COSTS

Costs to resolve the technical issues described in this plan are presented in Table III-1. The costs are escalated through FY 1987 for the 1985-2015 period.* For reference, actual technology costs for FY 1984 are also included. Costs and schedules shown in this edition of the HWMTP reflect funding projected through FY 1991 as proposed in the updated FY 1987 Budget Submission. Costs for out years are estimated and are derived from what are believed to be reasonable judgments of the resources (manpower, materials, and equipment) needed to close the technical issues. Because it is not possible now to precisely define resource requirements to close all issues, especially for those scheduled to be completed in later years, actual costs to resolve the various technical issues can be expected to differ somewhat from the estimates in Table III-1. This expected cost variability could be partially compensated by inclusion of contingency funds. However, contingency funds are not provided in the costs shown in Table III-1.

The total cost to close all issues is $315 million. About 47 percent ($148 million) of this cost relates to resolution of issues involved in disposal of existing and future double-shell tank wastes. Resolution of technical issues associated with disposal of wastes in single-shell tanks is estimated to cost $40 million. Resolution of issues involved with disposal of retrievably stored and newly generated transuranic (TRU) solid wastes is estimated to cost $37 million. Development of criteria and standards for disposal of all HSDW is estimated to cost $21 million.

Estimates of the technology costs shown in this report are made on the basis that all identified tasks for all issues associated with the reference disposal plan must be performed. Changes in the number and scope of individual tasks will be reflected in changes in the estimates of overall technology costs (see Section III.B).

Comparison of the costs (expense dollars) shown in Table III-1 with similar data listed in the December 1984 version of the HWMP shows that, in some cases (Technical Issues SST-7, CSS-4, SWB-3, DST-3, DST-6, DST-7, TRU-4, and TRU-5), estimated costs to close the issues are significantly higher or lower than in the December 1984 version. The new costs reflect: a) an updated FY 1987 Budget Submission; and b) improved and updated forecasts of the scope and extent of the work needed to close the issue. In Technical Issue DST-6, costs to close the issue are now estimated to be $20 million less than in costs to close the issue are now estimated to

*Costs for FY 1985 and FY 1986 are shown as 1985 and 1986 dollars, respectively. Costs for FY 1987 and out years are shown as FY 1987 dollars.

be $20 million less than in the December 1984 HWMTP; this apparent decreased cost results from the recognition that some materials/equipment must be purchased with capital funds rather than expense funds.

B. KEY TECHNICAL DECISIONS

Key technical decisions are, as noted previously, those which significantly impact the extent and cost of efforts needed to close a particular issue. Table III-2 is a compilation of all key technical decisions identified in individual flow diagrams in the HWMTP.

Table III-1. Estimated Annual Technology Costs ($1,000).

Symbol	Title	Total (excluding FY 1984)[a]	1984[b]	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995-2015
DCS	Disposal Criteria and Standards[c,d]	21,100	3,080	3,270	3,310	4,690	2,930	2,080	1,780	1,580	940	150	150	200
SST	Single-Shell Tank Wastes	40,000	1,560	4,280	5,480	6,300	6,480	7,040	5,790	3,780	740	0	0	0
CSS	Contaminated Soil Sites	14,600	3,420	2,040	2,580	2,430	2,090	650	830	380	3,010	570	0	0
SWB	Solid Waste Burial Sites	11,100	370	235	190	825	1,190	3,020	1,870	1,490	1,990	320	0	0
DST	Double-Shell Tank Wastes[e]	148,000	6,450	13,000	16,100	27,700	14,300	11,800	11,500	13,600	17,800	16,600	5,440	0
CAP	Capsules	2,080	210	165	185	0	0	0	200	200	470	430	430	0
TRU	Stored and New Solid TRU Waste[e]	36,900	960	1,120	1,590	3,400	6,800	6,090	6,110	5,410	500	5,900	0	0
MSC	Miscellaneous Wastes[f]	1,840	0	56	0	0	0	0	0	0	595	595	595	0
ETB	Enhanced Technology Base[f]	3,620	0	161	100	100	260	260	390	427	1,000	920	0	0
	NEPA documentation[d]	2,000	610	1,230	800	0	0	0	0	0	0	0	0	0
	Program Management and Planning[g,h]	25,400	1,940	1,340	2,670	3,060	2,080	2,080	2,080	2,080	2,000	2,000	2,000	4,000
	Expense Total	306,000	18,600	26,900	33,000	48,500	36,100	33,000	30,600	29,000	29,000	27,500	8,600	4,200
	Equipment (Capital)	8,800	1,200	500	590	1,270	2,840	1,600	900	700	0	200	200	0
	Total Expense and Equipment	315,000	19,800	27,400	33,600	49,800	39,000	34,600	31,500	29,700	29,000	27,700	8,800	4,200

[a]The total estimated technology costs include only those for FY 1985 and out years.

[b]Actual technology costs for FY 1984.

[c]Includes performance assessment and systems integration and planning.

[d]Costs for NEPA documentation included in DCS issues after FY 1986.

[e]Program management and planning are included as part of the costs to close all of the TRU technical issues and Technical Issue DST-6, Immobilization (Glass).

[f]Only partial funding has been allotted for this issue through FY 1991. Remaining costs are thus shown in FY 1992 and out years.

[g]These amounts are included until 1996 for comparison purposes.

[h]Does not include costs for Technical Issue DST-6 and all of the stored and new solid TRU waste issues (see footnote e).

TABLE III-2. List of Key Technical Decisions. (Sheet 1 of 3)

Waste class	Key technical decisions
Single-shell tanks	• SST-2 (1): Is the TRAC computer model valid? (i.e., can the majority of the single-shell tank waste be characterized using TRAC?)
	• SST-3 (1): Do any single-shell tanks exceed the heat limit for disposal?
	• SST-4 (1): Do any single-shell tanks exceed the limits for content of organic complexants?
	• SST-5 (1): Is it necessary to remove moisture from any single-shell tank after jet well pumping and prior to onsite stabilization and isolation?
	• SST-6 (1): Are dome filling techniques acceptable for all tanks?
Double-shell tanks	• DST-1 (1): Is Neutralized Cladding Removal Waste (NCRW) a TRU waste?
	• DST-1 (2): Will plant-scale TRU removal be performed?
	• DST-4 (1): Can retrieval methodology and equipment be used for more than one waste type?
	• DST-4 (2): Is it necessary to demonstrate retrieval from actual DST(s) or from tank mock-up(s)?
	• DST-5 (1): Is it necessary to remove zirconium from NCAW sludge?
	• DST-5 (2): Is it necessary to destroy organic complexants in complexant concentrate (CC)?
	• DST-5 (3): Is it necessary to destroy organic complexants in double-shell slurry (DSS)?
	• DST-5 (4): Is it necessary to remove TRU components from DSS?
	• DST-6 (1): Can selected Savannah River Plant (SRP) and West Valley Demonstration Project (WVDP) technology be used for vitrification equipment development and design?

TABLE III-2. List of Key Technical Decisions. (Sheet 2 of 3)

Waste class	Key technical decisions
Capsules	• CAP-2 (1): Is the waste package design acceptable for disposal in a geologic repository?
Contaminated Soil Sites	• CSS-5 (1): Is a field-scale demonstration of protective barrier technology for TRU contaminated soil sites necessary?
Solid Waste Burial Sites	• SWB-3 (1): Is in situ vitrification necessary for immobilization of TRU contaminated solid waste burial sites?
	• SWB-4 (1): Is a field-scale demonstration of protective barrier technology for TRU-SWB sites necessary?
Stored and New TRU Waste	• TRU-1 (1): Is technology acceptable for non-destructive assay and examination of contact-handled (CH) TRU wastes for the WRAP facility?
	• TRU-3 (1): Is a special CH-TRU retrieval facility required?
	• TRU-4 (1): Is the shred/grout process feasible and acceptable?
	• TRU-4 (2): Is existing technology available for reducing the size, as required, of CH-TRU wastes?
	• TRU-5 (1): Is a special remote-handled (RH) TRU retrieval facility required?
	• TRU-5 (2): Is development of size reduction technology required for retrieved RH-TRU waste?
	• TRU-5 (3): Is an existing facility (with modifications) suitable for processing and packaging RH-TRU waste?

TABLE III-2. List of Key Technical Decisions. (Sheet 3 of 3)

Waste class	Key technical decisions
Enhanced Technology Base	• ETB-2 (1): Is TRU removal from various PUREX waste solutions desirable and feasible? • ETB-3 (1): Is the removal of additional ^{90}Sr from new and existing waste needed? • ETB-3 (2): Is there an incentive to develop a new ^{90}Sr removal process?

IV. DISPOSAL CRITERIA AND STANDARDS

Preparation of the individual issue flow diagrams presented in this report has clearly underscored the need for performance assessments and quantitative standards and criteria* which can be used in resolving technical issues. Criteria and standards need to be developed for the following reasons:

- To ensure compliance with applicable Federal regulations
- For orderly and cost-effective development and implementation of waste processing and disposal systems. Without criteria and standards it is not possible to judge the adequacy of available technology or to evaluate trades leading to the most efficient systems
- To help define, together with results of appropriate engineering analyses, areas where additional technical development is needed.

The required standards and criteria must be firmly based upon applicable U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency (EPA) regulations and policies. It is anticipated that resolution of the disposal standards and criteria technical issues identified in the HWMTP, coupled with results of selected and specific engineering studies, will provide the needed guidance for the design of processing and disposal systems for Hanford Defense Waste.

A. SCHEDULES

Schedules for resolution of the Disposal Standards and Criteria technical issues are shown in Figure IV-1.

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*Criteria - General guidelines or principles from which quantitative or definitive standards are prepared to regulate activities. Example: The radioactive decay heat in onsite stabilized and isolated single-shell tanks must be controlled to maintain a thermally stable waste form and structurally stable tank components (e.g., concrete shell).

Standard - A standard is a quantitative measure of criteria satisfaction. Example: The maximum permissible temperature in onsite stabilized and isolated single-shell tanks is XXX $^{\circ}$C.

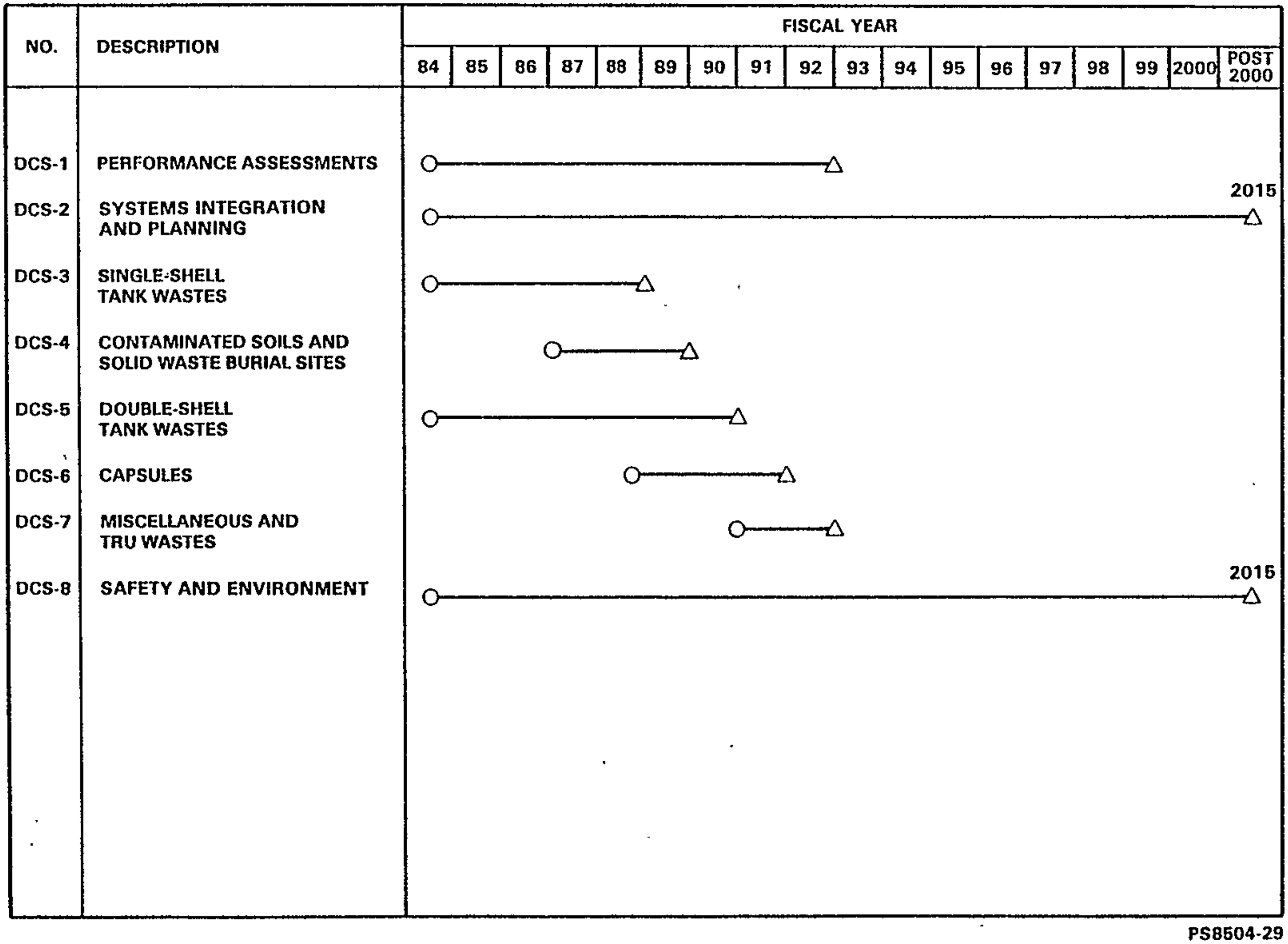

FIGURE IV-1. Schedules of Disposal Criteria and Standards Issues.

B. COST SUMMARY

Table IV-1 summarizes the costs associated with development of technology required to close the DCS issues.

TABLE IV-1. Estimated Technology Development Costs--Disposal Criteria and Standards.

Technical issue		Estimated costs ($1,000)		
Identification symbol	Title	Manpower	Capital equipment	Total
DCS-1	Performance Assessments	$ 6,440	$100	$ 6,540
DCS-2	Systems Integration and Planning	8,740	--	8,740
DCS-3	Single-Shell Tank Wastes	1,340	--	1,340
DCS-4	Contaminated Soil and Solid Waste Burial Sites	1,200	--	1,200
DCS-5	Double-Shell Tank Wastes	1,380	--	1,380
DCS-6	Capsules	400	--	400
DCS-7	Miscellaneous and Solid TRU Wastes	640	--	640
DCS-8	Safety and Environment	960	--	960
	TOTAL (rounded)	$21,100	$100	$21,200

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Technical Issue DCS-1

PERFORMANCE ASSESSMENTS

Statement of Issue

The technical issue is: What technology is required to support technically credible performance assessments of the reference plan for disposal of Hanford Site Defense Wastes (HSDW), and what additional technological developments (e.g., methodology, computer codes, data) are necessary to ensure that the health effects of the reference plan are "as low as reasonably achievable (ALARA)."

A performance assessment is an analysis that identifies the events and processes which might affect the waste disposal system, examines their effects upon its natural and engineered barriers, and estimates the probabilities and consequences of those events and processes (EPA, 1982). The purpose of a performance assessment is to provide technical bases for the selection of a site and a disposal system in order to minimize the deleterious impacts of disposal of HSDW on the population and environment. Management and disposal decisions related to all existing and future HSDW benefit from numerical analyses contained in performance assessments.

A performance assessment is used to enhance the engineering designs of disposal system components by: (1) establishing performance objectives to meet performance criteria, (2) evaluating design and cost trade studies and design verification, (3) considering ALARA objectives, (4) developing criteria and standards and establishing supporting design guidelines, (5) establishing predisposal site characterization and environmental baselines, and (6) establishing the scope and requirements for postdisposal performance monitoring. Numerical analyses using time-dependent models and computer codes aid in the evaluation of the disposal system (both natural and engineered components) by estimating the consequences of radionuclide and chemical release and their migration in terms of time, concentrations, and resultant impact to the environment and population. Use of computer models can lead to a better understanding of the disposal system, the impact caused by heat, radiation, and chemicals from disposal, and the impact of environmental change on the integrity of the system. The simulation results are intended to evaluate which of the onsite stabilization and disposal strategies and engineering options are attractive under existing and emerging regulatory requirements.

Scope

The scope of work for a performance assessment includes conducting actual assessments to meet programmatic requirements (e.g., disposal criteria and standards, single-shell tanks, etc.), and developing appropriate technology to augment existing analytical capability. The technology to perform various numerical analyses exists at different stages of development. Preliminary analyses can be performed from existing technology; however, because of oversimplifications, these analyses may be judged to be inadequate. More complicated computations using large data sets, two-phase flow, and chemical hazards and particularly considering the effects of parameter uncertainty may require additional technology development. The actual technology gaps, in terms of both analytical capability and available data, are only discovered through technology applications. Thus, responsible performance assessment needs both an application and a developmental perspective.

Status

There have been a number of assessments already performed (ERDA, 1975; ERDA, 1977; Wallace, 1982; Napier, 1982; Quinn et al., 1982; Rockwell, 1980a, 1980b, 1980c; NAS, 1978) that specifically evaluated Hanford Site waste management operations and alternative disposal methods. Additional analyses have been performed that contain information relevant to waste disposal issues at the Hanford Site (Isaacson, 1974; Brown, 1977; Finlayson, 1978). Onsite stabilization and disposal are being evaluated in the HDW-EIS as a programmatic alternative to disposal in a geologic repository. Additional analyses are currently in progress to evaluate specific onsite stabilization and disposal methods such as in situ vitrification and grout technology. Therefore, there is a need for an integrated modeling approach to aid in the evaluation of design options for projects beginning as early as 1985 (i.e., in situ vitrification, transportable grout facility, the TY tank farm disposal demonstration project) and in the development of criteria and standards for these and other near-term projects.

The technology development portion of the program for FY 1985 has been established by consideration of assessment requirements for Hanford disposal options in the light of current technology, and including insights gained through preparation of the HDW-EIS. The program highlights for FY 1985 are as follows:

- Continue resolution of recharge issues
- Document status and recommendations for Hanford geochemical data base
- Improve MINTEQ capabilities for organic complexants and high ionic strength solutions
- Document status and recommendations for source term analysis of waste release
- Document status and recommendations for uncertainty considerations in analytical modules
- Document anticipated performance assessments, prioritize future technology development needs, and obtain technical consensus.

Tasks to Close the Issue

The tasks to close the issues are divided into two groups: Performance Assessment Applications and Performance Assessment Development. The Performance Assessment Applications group includes the tasks required to implement numerical analysis for decision and regulatory purposes. The Performance Assessment Development group includes tasks needed to develop, calibrate, and validate performance assessment tools for use at the Hanford Site.

Performance Assessment Applications

Tasks to be completed are as follows:

DCS-1.1 System identification, conceptual models, and integration

Identify what performance assessments need to be performed in order to meet regulatory requirements and other programmatic needs. Develop issues hierarchy that relates Hanford waste management and disposal issues to information and data needs, types of analyses required, and selected computer codes and models. Identify data required to perform the assessments.

Develop conceptual models of the physical and chemical systems (typical assessment components include release analysis, flow analysis, transport analysis, and dose analysis). Identify performance assessment technology that is consistent with the complexity of the conceptual models. Identify technology gaps, prioritize needs, and initiate plans to improve analytical capability and the data base where appropriate. Develop and implement quality assurance for software and data. ($800,000)

DCS-1.2 Specific performance assessments

Perform numerical analyses for disposal technologies and other programmatic needs in support of engineering design evaluation, hydrologic transport analyses, dose evaluation, environmental assessments, etc. Where appropriate, Probabilistic Risk Assessment (PRA) methods will be incorporated. Performance assessments are anticipated to accommodate post closure analysis on major disposal actions, such as:

- HDW-EIS
- In Situ Vitrification Program
- Hanford Grout Technology Program
- Barrier and Marker Development Program
- Contaminated TRU Soil Site Stabilization
- Single-Shell Tank Stabilization

- Solid Waste Burial Site Stabilization
- Double-Shell Tank Waste Disposal
- Miscellaneous Waste Disposal
- Other Future Operations

($1,140,000)

Performance Assessment Technology Development Tasks

Tasks to be completed are as follows:

DCS-1.3 Improve data base

Identify data needs (hydrologic, geologic, geochemistry, chemical, atmospheric, etc.) and computer system needs. Develop plans for a comprehensive data base, establish administrative procedures, and enter quality controlled data. Immediate concerns include assessment of waste characterization data, assessment of solubility or release coefficients for fluid and vapor pathways, and organic ligand data for chemical solubility estimates. ($875,000)

DCS-1.4 Improve release analysis

Perform scenario analysis to develop baseline release conditions (most likely to occur) and statistical perturbations (much less likely to occur) of the natural system. Develop predictive leach models for waste form degradation and contaminant release in both liquid and vapor phases as well as by biotic transport. Update postclosure accident analysis capabilities for airborne contaminants. ($350,000)

DCS-1.5 Improve flow analysis

Determine hydraulic properties of unsaturated soil and rock materials from laboratory analysis and direct field measurements. Develop an unsaturated flow code that can handle extreme heterogeneities and transient flow conditions. Improve saturated flow analysis capabilities. As needed, further develop atmospheric flow modeling capability. Calibrate and validate models to the extent possible. This task includes resolution of questions concerning whether or not recharge of the groundwater occurs on the 200 Area Plateau under present climatic conditions. ($1,125,000)

DCS-1.6 Improve transport analysis

Develop, document, and verify computer codes that simulate contaminant transport in partially saturated media. Review transport mechanisms in liquid and vapor phases, contaminant-rock interactions, retardation phenomena, and coupled geochemical-hydrologic flow with a view toward both short-term and long-term application needs. Consider code modifications for simulations of chemical hazards and analytical enhancement for estimation of airborne contaminants. Calibrate and validate models. ($600,000)

DCS-1.7 Improve dose analysis

Evaluate biotic pathway and dose models for analytical improvements including quantification of parameter uncertainties. Incorporate radionuclides (e.g., ^{14}C) that are not currently in the dose models. ($250,000)

DCS-1.8 Incorporate uncertainty analysis

With few exceptions (e.g., risk analysis), most simulations for a performance assessment have been deterministic and have not considered statistical techniques. Uncertainty analysis should be included in considerations of release, flow, transport, and dose calculations. Also, uncertainty techniques should be incorporated into data analysis (prior to computer simulation) and into parameter optimization routines. ($800,000)

DCS-1.9 Incorporate chemical hazards technology

Identify and evaluate chemical hazards and incorporate methods for their consideration into existing performance assessment capabilities. Modify (and develop where necessary), document, and verify changes in computer codes. Identify requirements for new data and coordinate data and computer code modifications with other analytical modules. Calibrate or validate models when appropriate. ($500,000)

Flow Diagram

The logical order of performing the tasks required to close the performance assessment is shown in Figure IV-2.

Cost to Close the Issue

Manpower: $6,440,000
Capital Equipment: $100,000

Key Technical Decisions

No key technical decisions were identified as being required prior to providing a performance assessment capability. Performance assessments will be carried out on specific waste processing and disposal system concepts. Specific performance assessments will contribute to the development of criteria and standards, conceptual system design, safety analysis reports, environmental assessments, final system design, and other programmatic issues yet to be defined.

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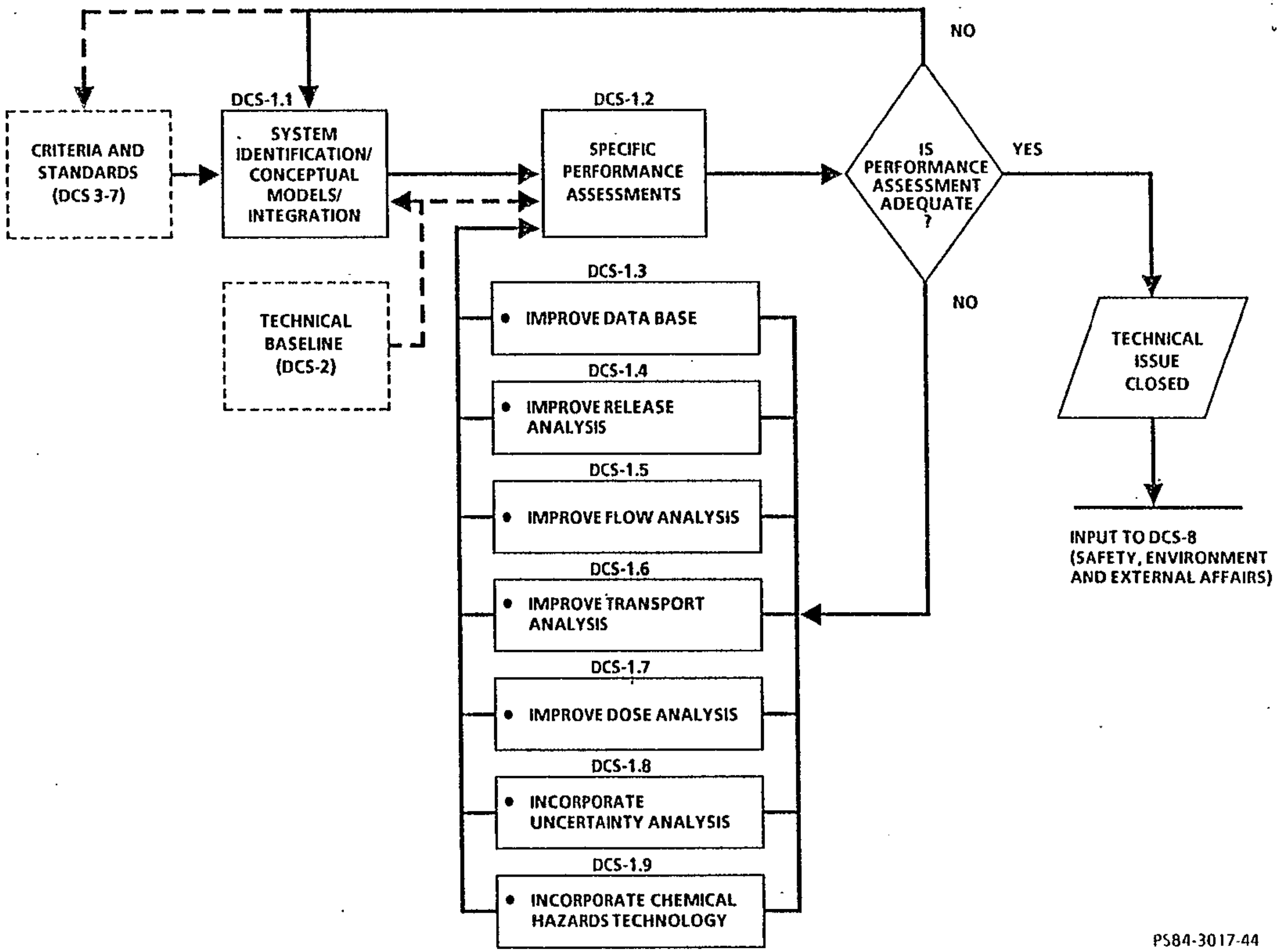

FIGURE IV-2. Flow Diagram DCS-1--Performance Assessments.

Technical Issue DCS-2

SYSTEMS INTEGRATION AND PLANNING

Statement of Issue

The technical issue is: What tasks must be completed to assure an integrated, well-planned program for safe disposal of Hanford Site defense wastes?

An ongoing effort is required to provide updated plans for technology development, baseline data accumulation/validation, and design and construction of waste processing systems and final disposal of Hanford defense waste. Systems and procedures must be developed and implemented for managing the growing mass of waste management data applicable to the design and operations of the waste processing and disposal system. The validity and traceability of the data must be assured, while consistent data must be readily available for use.

Scope

The range of activities required to close this issue include planning, systems integration, and data management. Specifically included are the following:

- Issue a detailed strategy document or plan for closure of this issue
- Update the Hanford Waste Management Plan and the Hanford Waste Management Technology Plan
- Provide technical support for budget preparation
- Administer the group of waste management consultants established in fiscal year (FY) 1984
- Conduct follow-up engineering associated with Hanford site-specific disposal planning
- Maintain and update the Waste Information Data System (WIDS)
- Develop and administer the Integrated Data Bank (IDB) initiated in FY 1984
- Provide cost and schedule support to the Hanford Waste Management Plan and Technology Plan updates
- Develop and implement a cost effective information management and information retrieval system that will provide good traceability for the bases of technical and programmatic decisions

- Develop and implement methodology for assuring that all waste processing and disposal system major requirements and criteria are identified and addressed

- Define and establish a system and heirarchy for baseline documents.

Status

A Waste Management Advanced Planning Group has been established. This group has been responsible for issuing past and current versions of the HWMP and the HWMTP. A group of highly qualified consultants has been established.

The Integrated Data Base (IDB) was initiated in FY 1984 to provide an administrative control on the release of data. The Waste Information Data System (WIDS) is the primary source of data for onsite inventories.

Tasks to Close the Issue

DCS-2.1 Issue a detailed strategy document or plan

This document will address the specific items identified in the scope section above and the tasks listed below, plus any additional items needed for closure of this issue which may be identified during the planning process. ($45,000)

DCS-2.2 Integrated Planning

Provide integrated planning as a basis for technology development and budgeting. ($3,250,000)

This task will include the following elements:

- Update the HWMP and HWMTP

- Provide technical support for preparation of budgets

- Prepare briefings on required waste management planning

- Administer the group of consultants established in FY 1984

- Conduct follow-up engineering associated with site-specific planning.

DCS-2.3 Develop and maintain IDB and WIDS

Maintain current data and administrative systems. Provide cost and schedule support to the Hanford Waste Management Plan and Technology Plan updates. ($3,460,000)

DCS-2.4 Develop a program-wide information management system

Develop and implement a cost effective information retention and retrieval system to provide good traceability of the bases for technical programmatic decisions. The system could involve establishing a central file for all internal correspondence and extending the retention time for internal reports in document control files. Establish a system and hierarchy of baseline documents. Two good sources of onsite experience are the FFTF and BWIP projects. ($1,200,000)

DCS-2.5 Develop and implement methodology for identifying system requirements

Methods are required to identify and organize all criteria and requirements that must be met before final waste processing and disposal systems can be implemented. Methods for organizing requirements may include requirement trees or requirement hierarchies.

Comprehensive system design studies may be employed to determine technical data requirements. ($785,000)

Flow Diagram

The logical order of performing the tasks to close this issue is illustrated in Figure IV-3.

Costs to Close the Issue

Manpower: $8,740,000

Key Technical Decisions

No key technical decisions were identified as being required for closure of this issue.

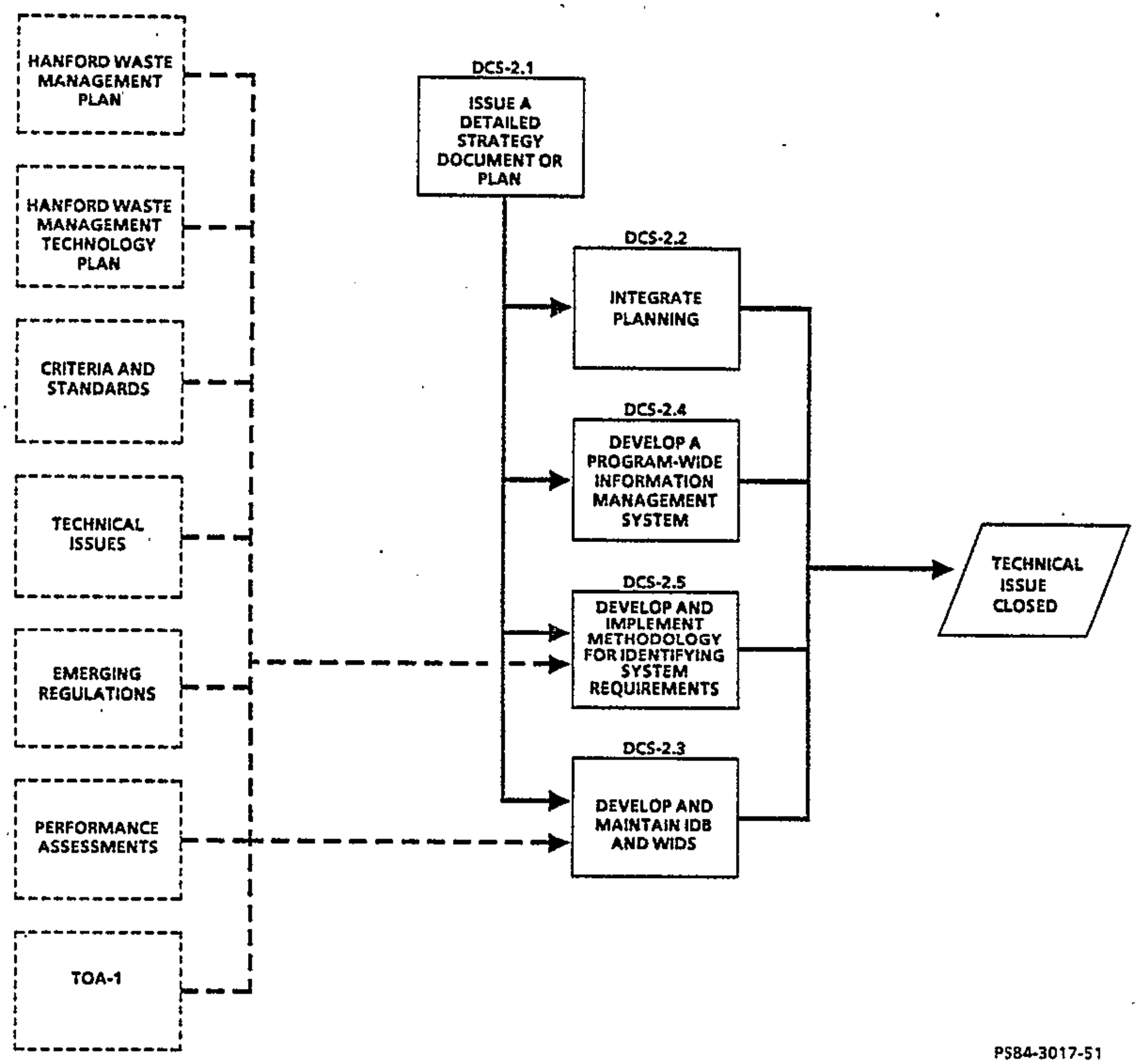

FIGURE IV-3. Flow Diagram DCS-2--Systems Integration and Planning.

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Technical Issue DCS-3

SINGLE-SHELL TANK WASTES

Statement of Issue

The technical issue is: What standards and criteria are needed to ensure environmentally acceptable in-place stabilization and disposal of single-shell tank wastes, and what technical tasks must be organized and completed to provide the required guidelines?

This technical issue involves those efforts required to develop criteria and standards for safe and cost-effective in-place stabilization and disposal of single-shell tank waste. These criteria and standards will address both radioactive and chemical waste hazards and must be consistent with DOE and EPA guidelines. They must address all parameters (e.g., moisture content, complexant level, etc.) that affect the design and performance of the disposal system.

Scope

Included in the scope of this issue are:

- Identification of those parameters for which criteria are necessary to provide adequate disposal of wastes in single-shell tanks.
- Statement of definitive standards for each parameter; such standards will be based on laboratory data, pilot plant data, field data, regulatory guidance, and environmental performance assessments.
- Development of the appropriate criteria and standards.

General criteria and specific standards required for disposal of single-shell tank wastes must, at a minimum, address the following parameters:

- Waste characterization (e.g., chemical and radiochemical contents)
- Waste temperature
- Complexant effects
- Moisture effects
- Disposal method (retrieval or in-place stabilization and disposal)
- Dome fill material
- Surveillance (postdisposal)

Status

A preliminary set of criteria and standards based primarily on draft regulatory guidance and appropriate scientific literature has been prepared. Predisposal characterization standards have also been drafted. Site specific field work, laboratory tests, and performance assessments will provide input for definitive criteria and standards.

The applicability of provisions of the Resource Conservation and Recovery Act (RCRA, 1976) and State of Washington Administrative Codes (WAC, 1976) to the disposal of radioactive and hazardous/toxic (nonradioactive) Hanford site waste has not yet been determined.

Tasks to Close the Issue

The following work must be completed to set forth criteria and standards for onsite stabilization and disposal of single-shell tank wastes:

DCS-3.1 Develop general criteria

Identify and develop the general criteria needed for in-place stabilization of single-shell tank wastes. Both radiological and chemical hazards will be considered. This task includes reviewing information developed as part of technical baseline analysis, disposal system plans, and existing and proposed regulations for waste disposal. Criteria developed will be technically defensible, based on existing and proposed regulations, and consistent with overall Hanford Site waste disposal criteria. Specific standards that are needed both for engineering guidance and disposal system performance evaluation will also be identified as part of this task. ($100,000)

DCS-3.2 Derive predisposal characterization standards

Predisposal characterization standards will specify the type of samples required from individual tanks, analytical procedures for extracting the samples, and documentation of these samples. All characterization data that are required by regulations must be obtained. ($210,000)

DCS-3.3 Derive maximum permissible waste temperature standards

Maximum permissible waste temperature standards will be established. The work required will include modeling of peak temperatures generated using various fill materials. ($140,000)

DCS-3.4 Determine organic complexant standards

Standards on the allowable amount of organic complexants in single-shell tank wastes will be determined. This task involves groundwater transport modeling using appropriate experimentally determined data on the uptake of radionuclides by Hanford Site soils from waste solutions containing complexants. ($140,000)

DCS-3.5 Establish moisture limits

Standards on the amount of moisture permissible in single-shell tank wastes prior to in-place stabilization will be established through thermodynamic modeling and calculation procedures. ($140,000)

DCS-3.6 Develop standards for isolation

Standards will be prepared for the type and degree of tank farm isolation required, including specifications for line cutting and capping methods and materials, riser removal, and removal or sealing of walls. This task also includes providing standards and criteria for markers and engineered barriers. Barrier criteria will address the long-term effects of surface erosion, groundwater transport, and plant, animal, and human disruption of the disposal site. ($260,000)

DCS-3.7 Specify standards for dome fill materials

Standards for dome fill materials will include specifications to be derived for the types of acceptable materials, for the degree of void fill required, and for chemical and mechanical properties of fill materials. ($200,000)

DCS-3.8 Develop postdisposal surveillance standards

Standards including types of required radiation detection instruments, frequency and duration of monitoring, and the documentation and reporting of data need to be established for the postdisposal period. ($150,000)

Flow Diagram

The logical order of performing the tasks required to close the single-shell tank wastes technical issue for disposal criteria and standards is illustrated in Figure IV-4.

Costs to Close Issue

Manpower: $1,340,000

Key Technical Decisions

No key technical decisions were identified as being required to develop disposal criteria and standards for single-shell tank wastes, beyond development of an overall Hanford Site disposal criteria and a definition of a consistent approach to establishing limits for each waste type.

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WAC (1984), "Dangerous Waste Regulation," Washington Administration Code, Olympia, Washington.

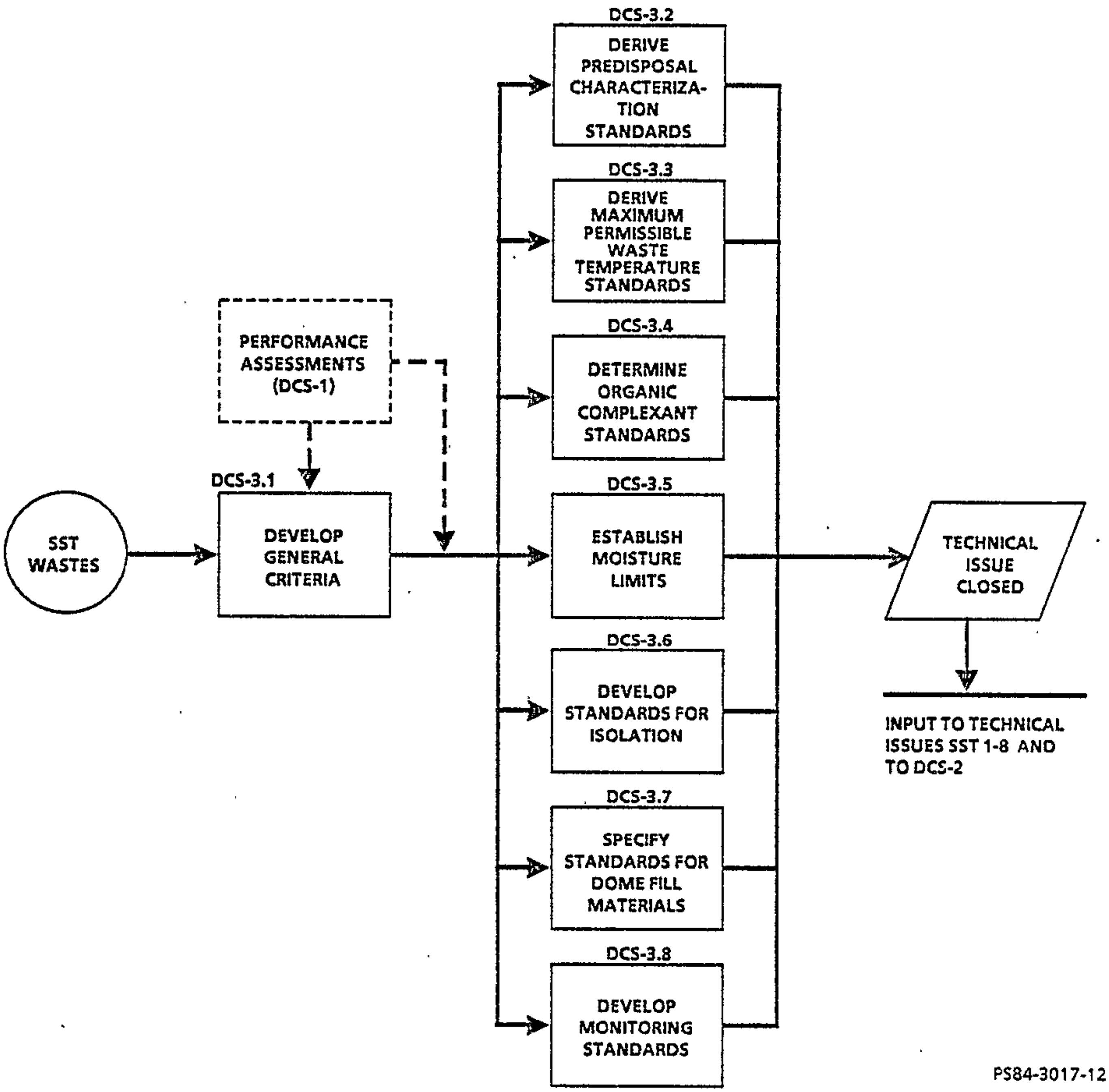

FIGURE IV-4. Flow Diagram DCS-3--Disposal Criteria and Standards for Single-Shell Tank Wastes.

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Technical Issue DCS-4

CONTAMINATED SOIL AND SOLID WASTE BURIAL SITES

Statement of Issue

The technical issue is: What standards and criteria are needed to ensure environmentally acceptable in-place stabilization and disposal of contaminated soil and solid waste burial sites, and what technical tasks must be organized and completed to provide the required guidelines?

This technical issue involves the work needed to derive criteria and standards that will provide guidelines for safe, yet cost-effective, in-place stabilization of contaminated soil and solid waste burial sites. Such criteria and standards will address both radioactive and chemical waste hazards and must be consistent with DOE and EPA regulations and guidelines. They must address all parameters (e.g., subsidence control, barriers, markers, etc.) that affect the design and performance of the disposal system.

Scope

This issue involves:

- Identification of those parameters for which criteria are necessary to provide adequate in-place stabilization and disposal of liquid and solid waste disposal sites.

- Statement of definitive standards for each parameter. Such standards will be based on field data, regulatory guidance, and environmental performance assessment.

- Development of the appropriate criteria and standards.

The need for criteria and standards has already been identified for the following waste disposal system parameters:

- Site characterization (predisposal)

- Subsidence control

- Barriers and markers

- Surveillance (postdisposal).

Status

Preliminary criteria were based primarily on draft regulatory guidance and appropriate scientific literature. Site specific field work and environmental performance assessments are required to produce definitive criteria and standards. Barrier field testing is underway; results from such testing will provide specific data for preparing barrier standards.

The applicability of provisions of the Resource Conservation and Recovery Act (RCRA, 1976) and State of Washington Administrative Codes (WAC, 1976) to the disposal of radioactive and hazardous/toxic (nonradioactive) Hanford site waste has not yet been determined.

Tasks to Close the Issue

The following tasks must be completed to obtain definitive disposal criteria and standards:

DCS-4.1 Develop general criteria

Identify and develop the general criteria needed for in-place stabilization of contaminated soil and solid burial sites. Both radiological and chemical hazards will be considered. This task will include reviewing disposal system plans and existing and proposed regulations for waste disposal. Criteria developed will be technically defensible, based on existing and proposed regulations, and consistent with quality assurance and overall Hanford Site waste disposal criteria. Specific standards that are needed both for engineering guidance and for evaluating disposal system performance will also be identified as part of this task. ($75,000)

DCS-4.2 Develop characterization standards

Site characterization standards which appropriately consider quality assurance considerations will specify the type and frequency of sampling and the analytical procedures and records. This task will address location of voids, toxic chemical and radionuclide distribution, and the proximity of aquifers. All characterization data required by regulations should also be addressed. ($70,000)

DCS-4.3 Develop subsidence control standards

Subsidence control standards which appropriately address quality assurance considerations and Greater Confinement Disposal will be prepared for both contaminated soil and solid waste burial sites. For contaminated soil sites, standards for void filling, line grouting, riser removal, and well sealing will be promulgated. For solid waste sites and caissons, types and degrees of subsidence control measures to be applied prior to barrier placement will be specified. ($290,000)

DCS-4.4 Develop waste form modification standards

Waste form modification standards will be prepared for both contaminated soil and solid waste sites. Currently envisioned techniques include In Situ Vitrification (ISV) and grouting. Standards will address both radiological and chemical considerations. Development of performance assessment tools of DCS-1 is a prerequisite to determining whether waste form modification is necessary or advantageous. ($490,000)

DCS-4.5 Develop barrier and marker standards

Barrier and marker standards will be formulated. As a prerequisite, unsaturated flow modeling will be conducted to predict long-term effects of surface barrier design on waste migration resulting from the accumulation of surface water infiltrating through the barrier. Long-term biotic transport modeling (as in DCS-3) is also required. Marker design and field test work are required, particularly for TRU sites, to develop markers that will remain intelligible for long periods. ($120,000)

DCS-4.6 Develop postdisposal surveillance standards

Postdisposal surveillance standards will include specification of radiation detection instrumentation, frequency and duration of monitoring, and documentation and reporting requirements. ($100,000)

DCS-4.7 Develop caisson disposal standards

Standards for the retrieval and/or disposal of Hanford caissons will be formulated. Specifications for the type of caisson fill material and the necessity for retrieval will be included. ($50,000)

Flow Diagram

Figure IV-5 illustrates the logical order of performing the tasks required to close the contaminated soil and solid waste burial sites technical issue for disposal criteria and standards.

Costs to Close the Issue

Manpower: $1,200,000

Bibliography

RCRA (1976), "Resource Conservation and Recovery Act," Washington, D.C.

WAC (1984), "Dangerous Waste Regulation," Washington Administration Code, Olympia, Washington.

Key Technical Decisions

No key technical decisions were identified as being required to develop disposal criteria and standards for contaminated soil and solid waste burial sites, beyond development of an overall Hanford disposal criteria and definition of a consistent approach establishing limits for each waste type.

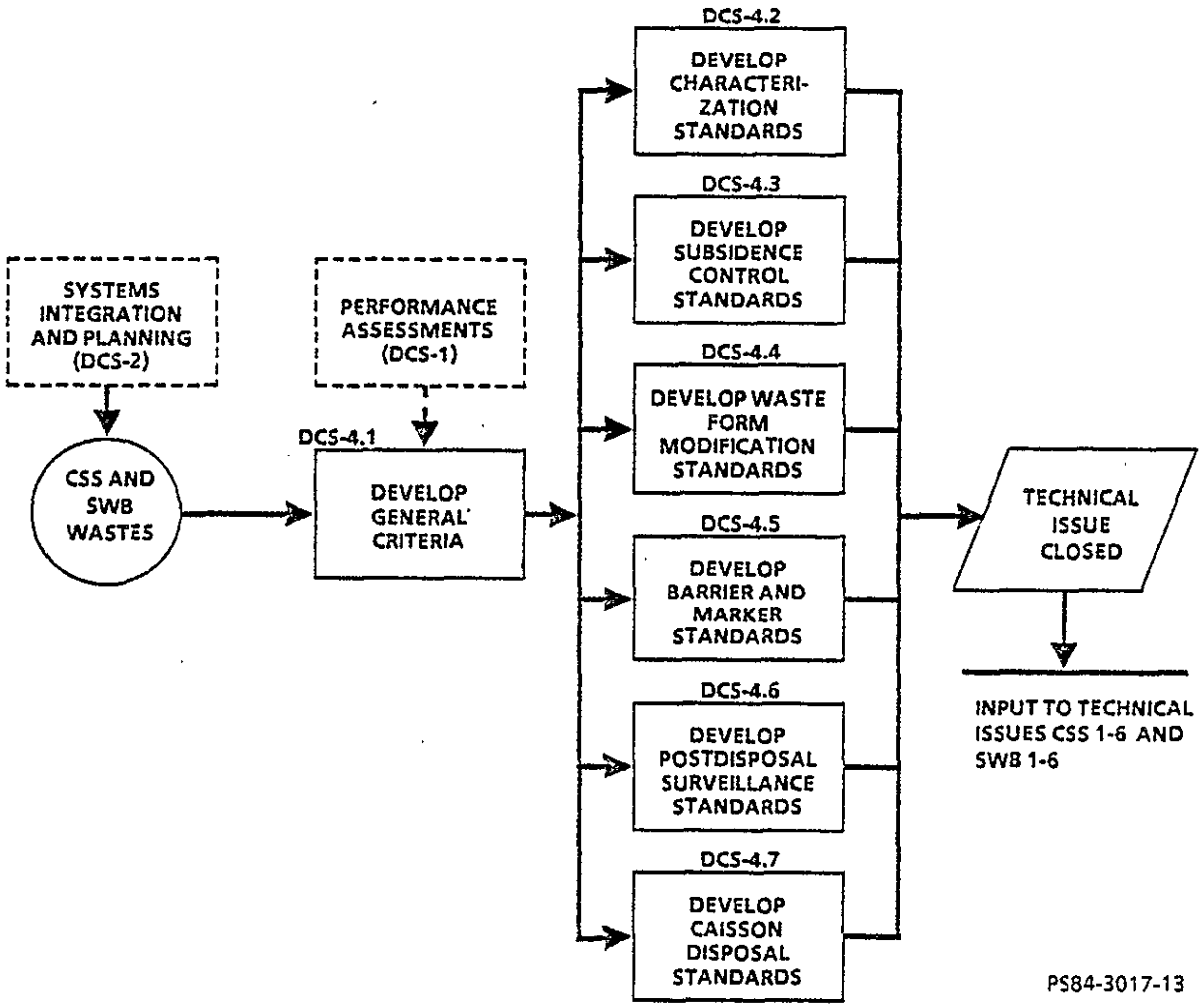

FIGURE IV-5. Flow Diagram DCS-4--Disposal Criteria and Standards for Contaminated Soil and Solid Waste Burial Sites.

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Technical Issue DCS-5

DOUBLE-SHELL TANK WASTES

Statement of Issue

The technical issue is: What criteria and standards are needed for environmentally acceptable disposal of existing and future double-shell tank wastes, and what technical tasks must be organized and completed to provide the required guidelines?

According to the current reference plan, the non-TRU fraction of double-shell tank wastes will be converted to a grout form for near-surface disposal while the TRU fraction will be vitrified for deep geologic disposal. All the criteria needed to design safe and cost effective systems for disposal of double-shell tank wastes have not been specifically identified. In particular, performance criteria and standards for development of both grout and glass waste forms as well as for the entire disposal system need to be derived. The criteria and standards should be both technically defensible and consistent with applicable regulations, orders, and guidelines. They should also address both radiological and chemical considerations and hazards.

Scope

The scope of this issue includes:

- Identification of those parameters for which criteria are necessary to provide guidelines for safe, yet cost-effective disposal of double-shell tank wastes.
- Statement of definitive standards for each significant parameter in the disposal system. Standards will be based on field data, regulatory guidance, and environmental performance assessments.
- Develop the appropriate criteria and standards.

Criteria and standards required for grouting of selected double-shell tank waste will, at a minimum, address the following disposal system parameters:

- Waste characterization (e.g., chemical and radionuclide contents)
- Disposal of empty double-shell tanks
- Waste form characteristics
- Disposal site requirements

- Barriers and markers

- Postdisposal surveillance.

Criteria and standards required for vitrification of selected double-shell tank wastes will, at a minimum, address the following parameters:

- Waste characterization (e.g., chemical and radionuclide contents)

- Waste form and package characteristics

- Interim storage and transport.

Status

Criteria and standards have not yet been developed specifically for the disposal of Hanford double-shell tank wastes. The HDW-EIS, which is currently being prepared, will permit decisions to be made regarding the implementation of disposal schemes using grout and glass waste forms. However, criteria and standards defining acceptable performance for these waste forms will not result from the NEPA process.

Site selection criteria were required for selection of the grout disposal sites by DOE Order 5820.2. These criteria were developed and the grout site has been selected. Site qualification criteria are being developed as the next step.

Based on proposed draft rulemaking, as presented in 10 CFR 262, the provisions of the Resource Conservation and Recovery Act (RCRA, 1976) and State of Washington Administrative Codes (WAC, 1976) do not apply to wastes stored in Hanford Site double-shell tanks.

Tasks to Close the Issue

The following tasks close the issue of criteria and standards for disposal of double-shell tank wastes:

DCS-5.1 <u>Develop general criteria for grout disposal</u>

Identify and develop general criteria for disposal of grouted wastes in a near-surface environment. Both radiological and chemical hazards will be considered. This task will include reviewing disposal system plans and existing and proposed regulations for waste disposal. Criteria developed will be technically defensible, based on existing and proposed regulations, and consistent with overall Hanford waste disposal criteria. Specific standards that are needed both for engineering guidance and for disposal system performance evaluation will also be identified as part of this task. (\$100,000)

DCS-5.2 Develop general criteria for disposal of vitrified wastes

Identify and develop general criteria for interim storage, transport, and repository disposal for vitrified wastes. Both radiological and chemical hazards will be considered. This task will include the review of disposal system plans and of existing and proposed regulations for waste disposal. Criteria developed will be technically defensible, based on existing and proposed regulations, and consistent with overall Hanford Site waste disposal criteria. Specific standards that are needed both for engineering guidance and for disposal system performance evaluation will also be identified as part of this task. ($75,000)

DCS-5.3 Develop feed stream characterization standards

Standards will be developed for characterizing the feed streams to the grout and glass plants. These standards will specify the radionuclides and chemicals of concern, the levels of sensitivity required, the frequency of sampling, the sample size, etc. ($75,000)

DCS-5.4 Develop standards for grout disposal

Standards will be developed for the entire grout disposal system including waste form performance for various radionuclides and potentially hazardous chemical constituents, waste form durability, and barriers. Specific emphasis in this task will be placed on waste form performance and durability. Standards for barrier design will be developed utilizing work done under technical issues DCS-4 and SST-7. ($250,000)

DCS-5.5 Develop standards for glass waste form and waste package performance

Repository disposal standards and regulations are established by several federal agencies. Existing and proposed regulations, standards, and guidelines for repository disposal will be utilized to tailor Hanford-specific standards that will define the required characteristics and performance of both the glass and the waste package. One element of this activity is the review of candidate waste streams to determine what can be disposed as a glass waste form. ($150,000)

DCS-5.6 Develop standards for interim storage and transport

Standards will be established with respect to record keeping for storage and certification of the glass canisters for shipment. ($50,000)

DCS-5.7 Develop double-shell tank disposal criteria

General criteria, based on existing and proposed regulation, standards, orders, and guidelines will be developed for disposal of double-shell tanks. This task will utilize work performed under technical issue DCS-3. ($100,000)

DCS-5.8 Develop standards for isolation of double-shell tanks

Standards will be prepared for the type and degree of tank farm isolation required, including line cutting, capping methods and procedures, riser removal, etc. ($75,000)

DCS-5.9 Develop standards for clean out and stabilization

Standards will be developed regarding the amount of residual waste or contamination that may remain in the tanks as well as defining the requirements for stabilization of the tanks. ($200,000)

DCS-5.10 Develop standards for barrier performance

Standards for barriers over the double-shell tanks will be developed. This work will take into consideration the level of residual waste and stabilization material to optimize the barrier requirements. Work regarding barriers performed under technical issues DCS-3, DCS-4, and SST-7 will be utilized by this task. ($200,000)

DCS-5.11 Develop postdisposal surveillance standards

Postdisposal surveillance standards will include specifications of monitoring instrumentation, frequency and duration of required monitoring, and reporting requirements. ($100,000)

Flow Diagram

Figure IV-6 illustrates the logical order of performing the tasks required to close the double-shell tank wastes technical issue for disposal criteria and standards.

Costs to Close the Issue

Manpower: $1,380,000

Key Technical Decisions

No key technical decisions were identified as being required to develop disposal criteria and standards for Double-Shell Tank Wastes, beyond development of an overall Hanford Site disposal criteria and definition of a consistent approach to establishing limits for each waste type.

Bibliography

RCRA (1976), "Resource Conservation and Recovery Act," Washington, D.C.

WAC (1984), "Dangerous Waste Regulation," Washington Administration Code, Olympia, Washington.

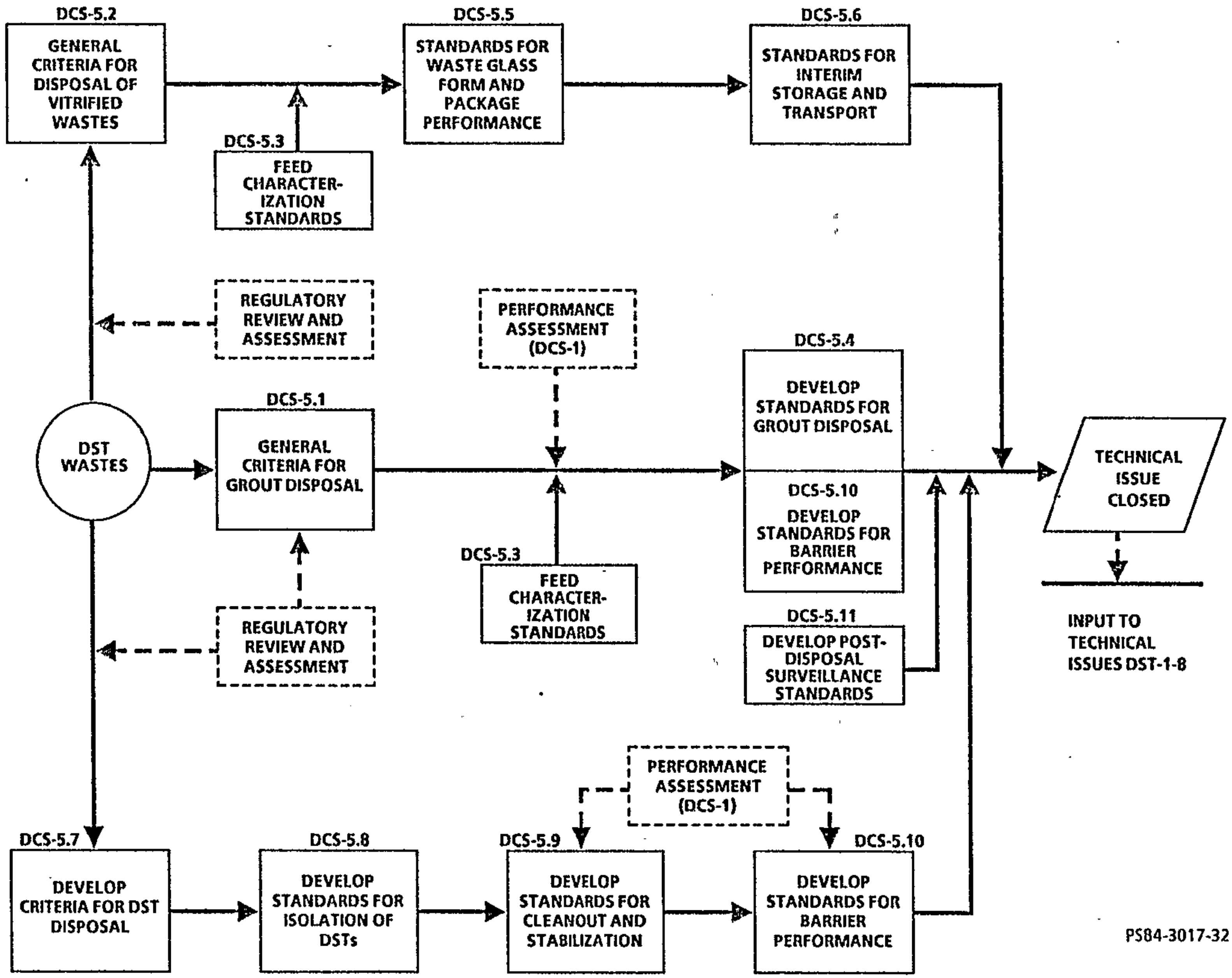

FIGURE IV-6. Flow Diagram DCS-5--Disposal Critiera and Standards for Double-Shell Tank Wastes.

Technical Issue DCS-6

CAPSULES

Statement of Issue

The technical issue is: What criteria and standards must be specified to ensure environmentally acceptable disposal of encapsulated $^{137}CsCl$ and $^{90}SrF_2$, and what technical tasks must be organized and completed to provide these guidelines?

This technical issue involves those efforts required to prepare criteria and standards for safe and cost-effective disposal of $^{90}SrF_2$ and $^{137}CsCl$ capsules and associated overpacks. These criteria and standards must be consistent with DOE and EPA guidelines and will address all parameters (thermal, corrosion, structural, etc.) that affect the design and performance of the overall capsule disposal system.

Scope

Included in the scope of this issue are:

- Identification of those parameters for which criteria and standards are necessary to provide adequate disposal of the capsules
- Development of the specific criteria and standards for each parameter; such criteria and standards will be based on laboratory work, field data, regulatory guidance, and environmental performance assessments.

Criteria and standards required for disposal of capsules will, at a minimum, address the following disposal system parameters:

- Encapsulated products
- Corrosion limits
- Thermal limits
- Overpack materials
- Waste form characteristics
- Interim storage and transport

Status

Although complete criteria and standards for disposal of encapsulated wastes are not yet available, some relevant progress has been made toward the definition of such standards. Analytical and laboratory work to define capsule performance at anticipated geologic repository temperatures has been completed for strontium capsules (Fullam, 1981) and has begun for cesium capsules. Thermal analyses of several overpacks and emplacement options have been completed. Standards previously established for $^{137}CsCl$ and $^{90}SrF_2$ quality, capsule weld quality, and capsule curie content are used routinely during encapsulation operations.

Tasks to Close the Issue

To arrive at a set of criteria and standards for disposal of encapsulated waste in deep geologic strata, the following tasks must be completed:

DCS-6.1 Develop general criteria

This task will include reviewing disposal system plans and existing and proposed regulations for waste disposal. Criteria developed will be technically defensible, based on existing and proposed regulations, and consistent with overall Hanford Site waste disposal criteria. Specific standards needed both for engineering guidance and disposal system performance evaluation will be identified. ($75,000)

DCS-6.2 Establish thermal, corrosion and structural standards

Thermal, corrosion, and structural standards will be established for capsule overpacks. These standards will address requirements for interim storage, transport and repository disposal. ($150,000)

DCS-6.3 Establish disposal standards for the waste form and waste package

Standards for the waste package and waste form, applicable for repository disposal, will be established. These standards will be the basis for package and waste form design constraints. Thermal limits, radiation limits, and material compatibility properties will be considered. ($175,000)

Flow Diagram

Figure IV-7 illustrates the logical order of performing the tasks required to close the capsules technical issue for disposal criteria and standards.

Costs to Close the Issue

Manpower: $400,000

Key Technical Decisions

The key technical decisions identified as being required to develop disposal criteria and standards for capsules, include development of an overall Hanford Site disposal criteria, definition of a consistent approach to establishing limits for each waste type, and a decision to whether capsules will be disposed onsite or stored and later shipped to a repository for disposal.

Bibliography

Fullam, H. T. (1981), Compatibility of Strontium-90 Fluoride with Containment Materials at Elevated Temperatures, PNL-3833, Pacific Northwest Laboratories, Richland, Washington.

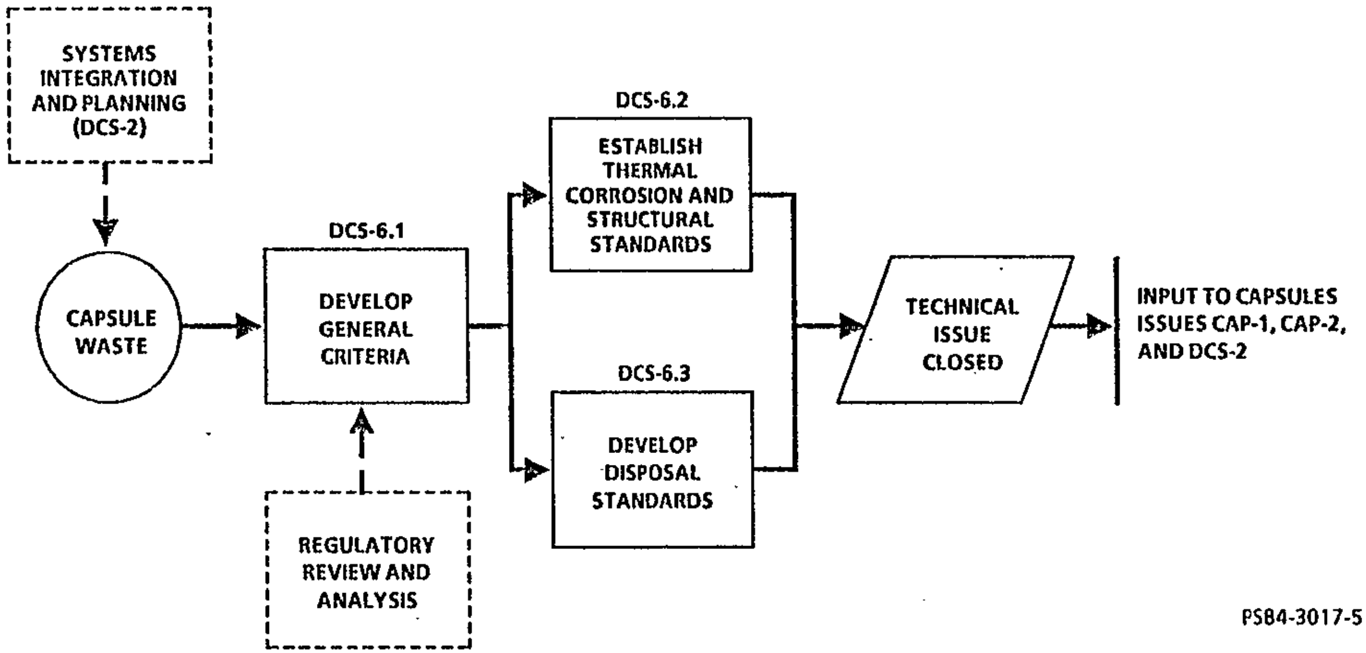

FIGURE IV-7. Flow Diagram DCS-6--Disposal Criteria and Standards for Capsules.

Technical Issue DCS-7

MISCELLANEOUS AND SOLID TRU WASTES

Statement of Issue

The technical issue is:

(a) Exactly which criteria and standards are needed for environmentally acceptable disposal of miscellaneous radioactive wastes, toxic substances, and hazardous material stored at the Hanford Site, and what tasks must be organized and completed to provide the required guidelines?

(b) What criteria are needed for the onsite handling, storage, and treatment of solid TRU wastes?

Specialized procedures, techniques, and systems, beyond those developed for other types of wastes, are required for handling and disposal of miscellaneous radioactive waste, toxic substances, and hazardous material stored at the Hanford Site. Criteria and standards that clearly define the guidelines for proper disposal of miscellaneous wastes need to be established. Criteria for onsite handling and treatment of solid TRU wastes must be consistent with Waste Acceptance Criteria established by the Waste Isolation Pilot Plant (WIPP/WAC).

Scope

The scope of this task includes:

- Identification of those parameters for which standards are necessary to provide adequate disposal of radionuclides, hazardous materials, and toxic substances
- Analysis and evaluation of national hazardous and toxic waste regulations and standards for adaptation of those technical bases that are applicable to mixed-waste streams
- Preparation of definitive standards for each aspect of the disposal system based on field test data, regulatory guidance, and environmental performance assessments
- Development of criteria associated with the Waste Receiving and Packaging (WRAP) Facility for solid TRU wastes.

Standards are required for the following identified miscellaneous waste streams:

- Radioactive sodium metal
- Radioactive organic solvents, solutions, and mixtures including complexing agents.

Status

A Resource Conservation and Recovery Act (RCRA) Part B Permit Application is being prepared for submittal to the EPA. The Permit Application will identify those miscellaneous wastes containing both radioactive and hazardous chemical constituents that will be regulated under the RCRA. The application is scheduled for submittal by November 1985.

Tasks to Close the Issue

Completion of the first two tasks in the following list is necessary prior to development of standards for currently identified miscellaneous wastes. Additional technological developments may be necessary to establish standards for disposal of future miscellaneous wastes. These technology needs will be incorporated into appropriate criteria as they are identified.

DCS-7.1 Develop general criteria for miscellaneous wastes

This task will include reviewing disposal system plans and existing and proposed regulations for waste disposal. Criteria developed will be technically defensible, based on existing and proposed regulations, and consistent with overall Hanford Site waste disposal criteria. Specific standards needed both for engineering guidance and disposal system performance evaluation will be identified. ($75,000)

DCS-7.2 Derive standards for sodium and organic liquids

Derive standards for treatment and disposal of contaminated sodium metal and stored radioactive organic liquids. Specification of standards will address required waste characterization and treatment (e.g., incineration, etc.) and procedures and requirements of the disposal system. ($165,000)

DCS-7.3 Derive standards for disposal of other miscellaneous wastes

Tasks are yet to-be-determined to derive standards for other as yet unidentified miscellaneous wastes. ($250,000)

DCS-7.4 <u>Develop general criteria for the onsite handling, storage, and treatment of TRU waste</u>

Identify and develop general criteria needed for the onsite handling, storage, and treatment of TRU waste. This task includes criteria associated with the Waste Receiving and Packaging Facility (CH and RH) and would address dose rates, criticality, flammability, pressurization potential, reactivity, and hazardous chemical constituency of handled waste. Criteria developed will be consistent with waste acceptance criteria established by the Waste Isolation Pilot Plant. ($50,000)

DCS-7.5 <u>Develop waste form modification standards</u>

Develop waste form modification standards for TRU waste sites. Development of performance assessment tools of DCS-1 is a prerequisite to determining whether waste form modification is necessary or advantageous. ($100,000)

Flow Diagrams

Figure IV-8 illustrates the logical order of performing the tasks required to close the miscellaneous wastes technical issue for disposal criteria and standards.

Costs to Close the Issue

Manpower: $640,000

Key Technical Decisions

No key technical decisions were identified as being required to develop disposal criteria and standards for miscellaneous wastes, beyond development of an overall Hanford disposal criteria and definition of a consistent approach to establishing limits for each waste type.

Bibliography

RCRA (1976), "Resource Conservation and Recovery Act," Washington, D.C.

WAC (1984), "Dangerous Waste Regulation," Washington Administration Code, Olympia, Washington.

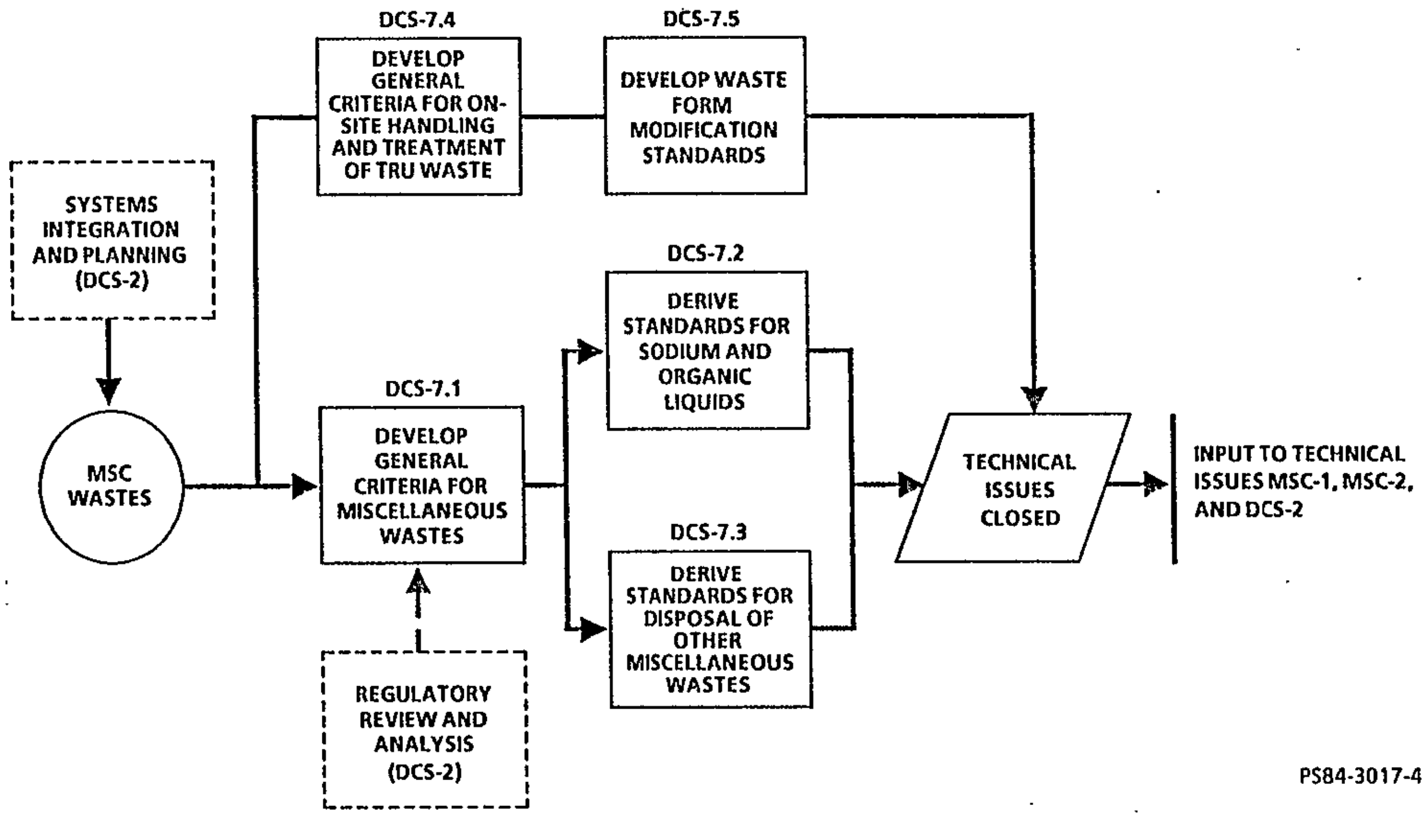

FIGURE IV-8. Flow Diagram DCS-7--Disposal Criteria and Standards for Miscellaneous and TRU Wastes.

Technical Issue DCS-8

SAFETY AND ENVIRONMENT

Statement of Issue

The technical issue is: What safety and environmental documentation is needed to ensure that compliance with regulations is achieved and the public is adequately informed?

Safety and environmental documentation must present pertinent information relative to the impacts of implementation of the disposal actions for Hanford Defense Waste. This documentation is required by federal law and DOE Orders, specifically the National Environmental Policy Act and DOE Orders 5440.1B, 5481.1, and 5481.1A.

Safety and environmental documentation will serve as a mechanism to provide the reasonable observer with confidence that disposal actions at the Hanford Site are being conducted in a safe and responsible manner.

Scope

Safety and environmental documentation will be required for all major disposal actions. Such disposal actions may include:

- Hanford Waste Vitrification Plant (HWVP)
- In Situ Vitrification (ISV)
- Stabilization of Contaminated Soil Sites
- Transportable Grout Facility (TGF)
- B Plant Process Implementation
- Single-Shell Tank Stabilization
- Contact/Remote Handled TRU Waste Receiving and Packaging (WRAP) Facility
- Stabilization of Solid Waste Burial Sites

Safety documentation will identify operational hazards and risk acceptability. Environmental documentation is part of a broader process and will support decision making for the selection of specific disposal actions and their impacts upon the environment. Specific tasks and associated costs for providing environmental and safety documentation are addressed in the appropriate disposal technology issues; e.g., DST-6 [Immobilization (Glass)] and DST-7 [Immobilization (Grout)]. The scope of this issue specifically addresses preparation of the HDW-EIS.

Guidance for preparation of safety and environmental documentation is found in the DOE Environmental Compliance Guide (DOE, 1981).

Status

An environmental documentation strategy planning document has been prepared and is in draft form. Safety documentation for three of the projects is scheduled. A briefing is planned prior to the release of the HDW-EIS to inform state officials that the Draft EIS will be released in February 1986.

Tasks to Close the Issue

The following tasks are required to close the Safety, Environmental, and External Affairs Issue:

DCS-8.1 Prepare and issue EIS and record-of-decision

An EIS is an extensive environmental assessment of a broader scope than an EA. Environmental Impact Statements include probabilistic risk assessment techniques. These documents require extensive public review. ($960,000)*

Flow Diagrams

A flow diagram indicating interaction between the subject activities to close the technical issue is provided in Figure IV-9.

Costs to Close the Issue

Manpower - $960,000

Key Technical Decisions

None.

Bibliography

DOE (1981), Environmental Compliance Guide (DOE/EV-0132), U.S. Department of Energy, Washington, D.C.

*Includes costs for Rockwell Hanford Operations only. Pacific Northwest Laboratory costs are not included.

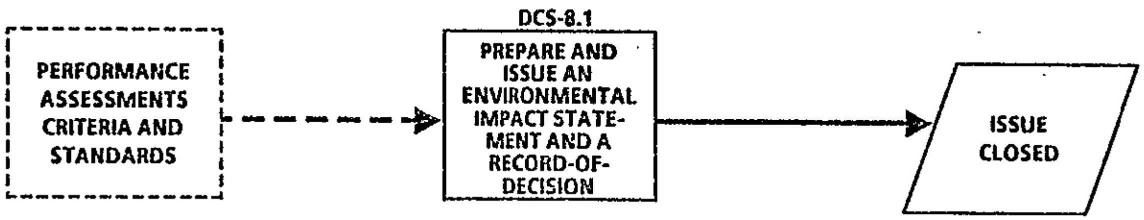

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FIGURE IV-9. Flow Diagram DCS-8--Safety and Environment.

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V. SINGLE-SHELL TANK WASTES

A. REFERENCE DISPOSAL PLAN

The reference plan described in the HWMP for disposal of single-shell tank (SST) waste is shown in Figure V-1. Table V-1 lists significant dates associated with disposal of SST waste.

B. SCHEDULE

Schedules for resolving the technical issues are shown in Figure V-2.

C. COST SUMMARY

Table V-2 summarizes the costs (escalated through FY 1987) associated with development of technology required to close the SST technical issues.

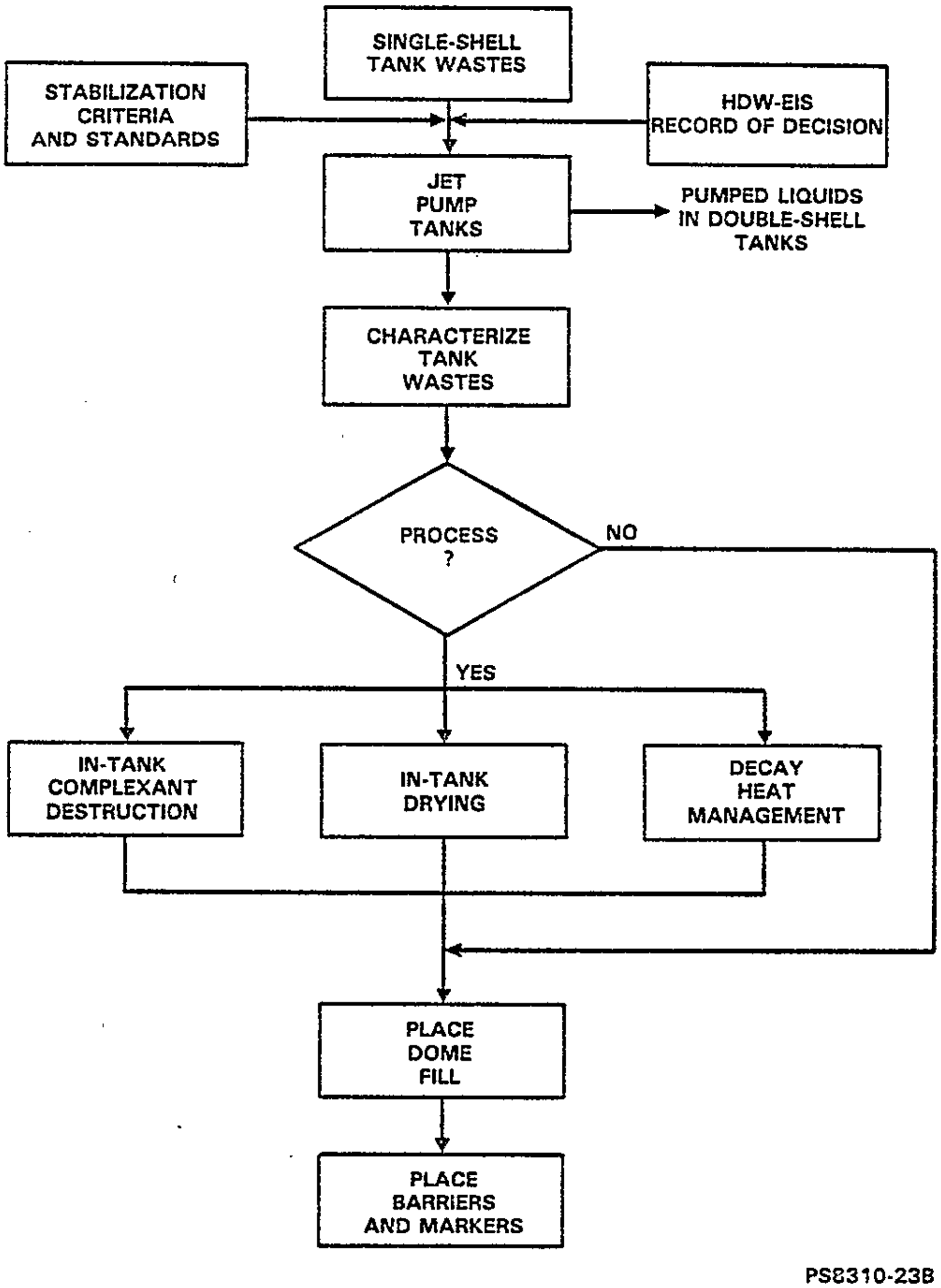

FIGURE V-1. Reference Plan for In-Place Stabilization and Disposal of Single-Shell Tank Wastes.

TABLE V-1. Significant Hanford Waste Management Dates--
Single-Shell Tank Wastes.

FY 1987-1991	Conduct single-shell tank in-place stabilization and disposal demonstration (TY farm)
FY 1991	Complete interim stabilization of all single-shell tanks
FY 1991	Complete interim isolation of all single-shell tanks
FY 1990-2010	Operational final stabilization and isolation of most single-shell tanks
FY 2030	Complete isolation and stabilization of high-heat single-shell tanks

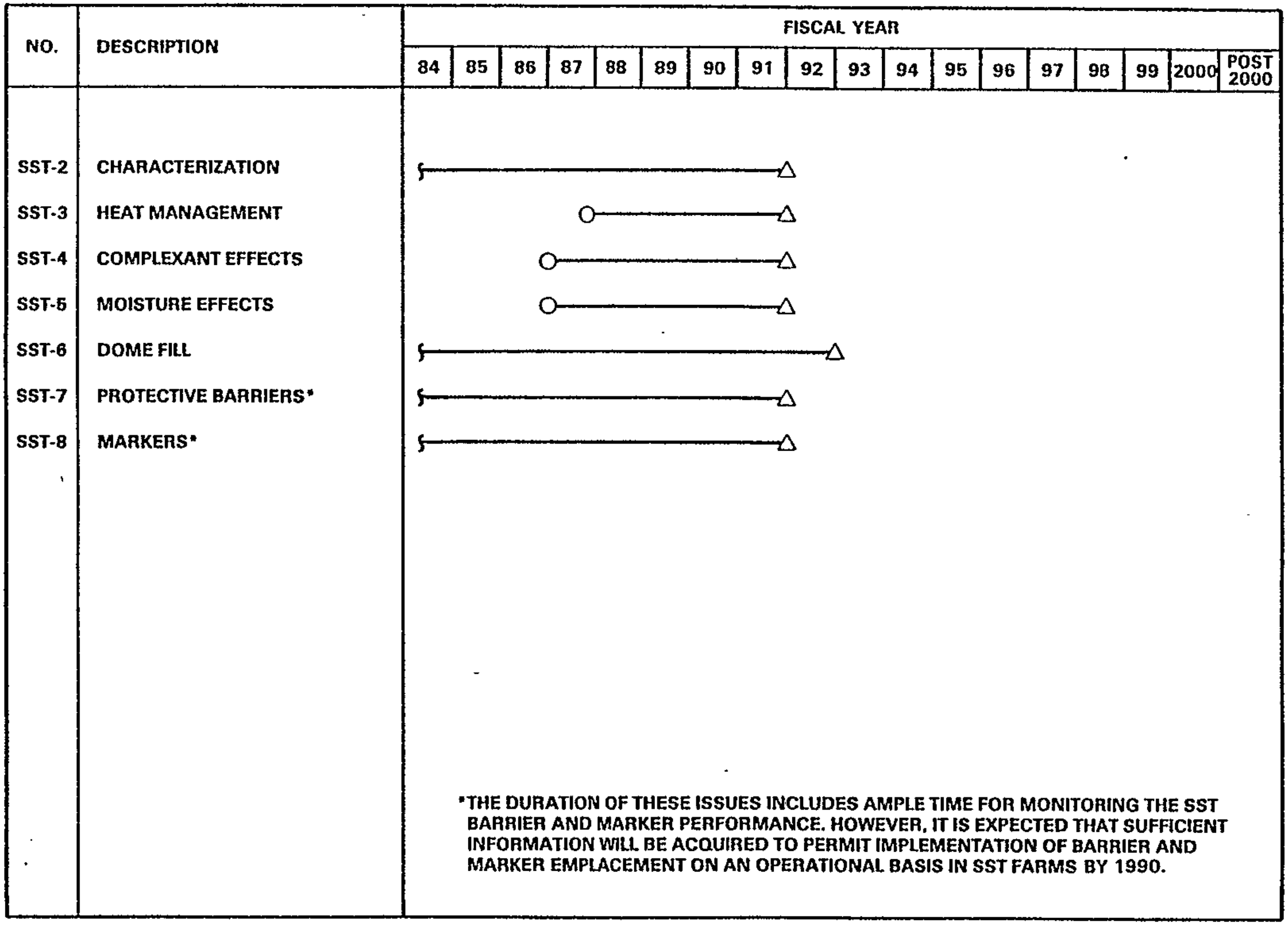

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FIGURE V-2. Schedules for Resolving Single-Shell Tank Technical Issues.

TABLE V-2. Estimated Technology Development Costs--Single-Shell Tank Wastes.

Technical issue		Estimated costs ($1,000)			
Identification symbol	Title	Manpower	Material	Capital equipment	Total
SST-1	Interim Management	a	a	a	a
SST-2	Characterization	$16,600	$ 270	$1,910	$18,800
SST-3	Heat Management	840	210		1,050
SST-4	Complexant Effects	2,870	315	245	3,430
SST-5	Moisture Effects	2,740	200	235	3,180
SST-6	Dome Fill	5,780	980	700	7,460
SST-7	Protective Barriers[b]	6,910	2,020	155	9,080
SST-8	Markers[b]	200	20		220
	TOTAL (rounded)	$36,000	$4,020	$3,240	$43,300

[a]Costs for Interim Management shown in Appendix B.

[b]Includes Costs for Contaminated Soil Sites and Solid-Waste Burial Sites.

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Technical Issue SST-1

INTERIM MANAGEMENT

For reasons stated on page I-4, this Technical Issue is now addressed in Appendix B.

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Technical Issue SST-2

CHARACTERIZATION

Statement of Issue

The technical issue is: What are the amounts, composition, physical properties, and chemical properties of the SST wastes?

To accomplish in-place stabilization and disposal of SST wastes in a safe and cost-effective manner, information concerning the chemical, radiological, and physical properties of the wastes is needed. Sampling and analysis techniques, equipment, and procedures are needed to develop a data base for use in the technical baseline (DCS-2). Tasks which must be completed to obtain the necessary characterization information are described in this technical issue.

Scope

Waste characterization includes the development of a plan to assemble and validate existing characterization data and to acquire additional data as required. The waste characterization data will be used to form a data base for the SST wastes.

Three methods of characterization are being pursued: (1) simulation modeling, (2) sampling and analysis, and (3) in-tank measurements. Development work is required to calibrate and validate the TRAC (Track Radioactive Components) computer model which is used to estimate the total waste inventory and the distribution of waste components among tanks. Core sampling equipment which takes waste samples from the single-shell tanks while maintaining the waste layers will be demonstrated. In situ measurement techniques will also be developed; these allow detection of radionuclides over a larger area than core sampling, but are not nuclide specific. Data from all three methods will be used to characterize the waste in the tanks. There is a strong economic incentive to use the computer model to predict each tank's contents. In the absence of a model, samples must be taken from each single-shell tank. If the model can be validated, core sampling and in situ measurement efforts can be reduced. Core sampling and in situ measurements of waste from selected tanks are required for the following reasons:

- To provide physical, chemical, and radionuclide data required to plan for continued interim management and for final disposal of wastes in SSTs.

- To provide input for risk assessments and engineering analysis.

- To calibrate and validate TRAC.

- To determine waste profiling data.

Characterization of the hazardous waste distribution and inventory is included in the scope of this issue.

Methods to validate and manage new data will be developed. Input from regulatory requirements, risk assessment, and TRAC validation/calibration will be combined with statistical analysis to determine sampling and analysis priorities.

Status

A computer program (TRAC) is being developed to predict how radionuclides and process chemicals have been distributed among underground SSTs through 1980. The data base for this computer model is currently being audited and updated and should be ready for use in early FY 1985.

The wastes in 12 SSTs have been sampled and analyzed. These data have been reviewed, and it has been determined that they cannot provide a basis for the calibration of TRAC.

The equipment required to acquire samples for model calibration and validation has been developed. A sampling system with the capability to retain samples with consistencies ranging from fluids to hard salt has been built.

A SST sampling and analytical plan has been developed. The approach presented in the plan uses core sample/analysis results to provide calibration data for the TRAC computer model. The plan identifies 20 tanks that will be sampled to calibrate TRAC. After TRAC is calibrated it will be used to identify an additional ten SSTs to be sampled for the validation of TRAC. After TRAC has been validated, it will be used to provide characterization information on the unsampled SSTs.

Qualified methods and procedures for receiving and breaking down SST waste samples and for analyzing the chemical, physical, and radioactive characteristics of SST wastes were completed in FY 1984.

Tasks to Close the Issue

SST-2.1 Develop and demonstrate in situ profiling techniques

Demonstrate in-tank profiling utilizing active and passive detection techniques (e.g., neutron, gamma, and beta measurements). Instrumentation to perform these measurements has been applied to disposal sites other than tanks. Modifications to the equipment are necessary for access to the tanks and to accommodate dose rates encountered during in-tank measurements. ($200,000)

SST-2.2 <u>Correlation of samples and in situ measurements</u>

Provide correlations between measurements made in the laboratory on sampled waste and in-tank profiling measurements. These correlations can be used for nondestructive measurements of the same type of waste. ($20,000)

SST-2.3 <u>Recover and analyze multiple waste cores from three tanks</u>

Multiple waste cores will be removed from three TY-farm tanks to evaluate the reproducibility of the sampling equipment and the uniformity of waste fill in the tanks. These multiple waste cores will also be used to evaluate existing analytical techniques. ($435,000)

SST-2.4 <u>Evaluate sampling and analysis procedures</u>

When analysis of the multiple waste cores is complete, an evaluation of the sampling and analysis design and procedures will be performed. This evaluation will determine if the collected data are of the quality required for the calibration of TRAC and will be used to decide if the sampling program needs to be modified. ($10,000)

SST-2.5 <u>Modify sampling and analysis procedures</u>

If necessary, modify sampling design and procedures to improve quality of data. ($10,000)

SST-2.6 <u>Confirm identity of waste tanks for TRAC calibration</u>

A preliminary list was identified in a tank sampling and analytical plan. The TRAC inventory data base will be used to confirm the identity of the tanks that require sampling for the calibration of TRAC. ($10,000)

SST-2.7 <u>Refine TRAC</u>

The TRAC model requires additional development work to refine the model to a point where it can be used to characterize the wastes contained in the SSTs. ($1,950,000)

SST-2.8 <u>Sample and analyze waste from 17 waste tanks</u>

Sample and analyze wastes in the selected SSTs. These tanks include three unsampled TY-farm tanks and the 14 tanks identified for (TRAC) calibration. ($1,410,000)

SST-2.9 Calibrate TRAC

Calibrate TRAC model using the new analytical data from the tank sampling program. ($98,000)

SST-2.10 Select ten SSTs for TRAC validation

Use the calibrated TRAC computer program to select ten tanks that will provide that data required for the validation of TRAC. ($10,000)

SST-2.11 Sample and analyze waste from ten selected tanks

The ten tanks identified by the calibrated model will be sampled and analyzed. ($850,000)

SST-2.12 Determine confidence level of TRAC model

The level of confidence that can be placed in TRAC predictions will be quantified. The confidence that is calculated will be compared with requirements, and a decision will be made on whether TRAC can be used to characterize the SST wastes or if additional sample data are required on the remaining tanks. ($70,000)

SST-2.13 Characterize SST wastes using TRAC

Characterize SST wastes using TRAC. Continue to update the TRAC model including: extension of composition and transaction bases to all waste streams and waste management activities, modification of phase transition models, provision for documentation of supporting data, and weighted value inventories for each waste component. ($409,000)

SST-2.14 Complete characterization of SSTs using core sampling

If necessary, perform core sampling of the remaining 119 SSTs to determine characteristics of the wastes. ($10,900,000--assumes 30 of the SSTs were sampled to calibrate/validate TRAC)

SST-2.15 Identify Release Mechanisms

Mechanisms controlling the release of hazardous chemicals and radionuclides from single-shell tanks will be identified. Releases will be related to site inventories, waste form characteristics, local hydrogeology, and soil properties. Models that quantify the release from individual sites and groups of sites will be developed as input to performance assessments. This task will serve as input to DCS-1.4, -1.6, and -1.9. ($200,000)

Flow Diagram

Figure V-4 illustrates the logical order of performing the tasks required to close the characterization technical issue for SST wastes.

Costs to Close the Issue

Manpower:	$16,600,000
Materials:	$270,000
Capital Equipment:	$1,910,000

Key Technical Decisions

- SST-2 (1): Is the TRAC computer model valid? (i.e., can the majority of the SST waste be characterized using TRAC?).

A "yes" answer would eliminate the need to perform the complete characterization of SSTs using core sampling. ($10,900,000)

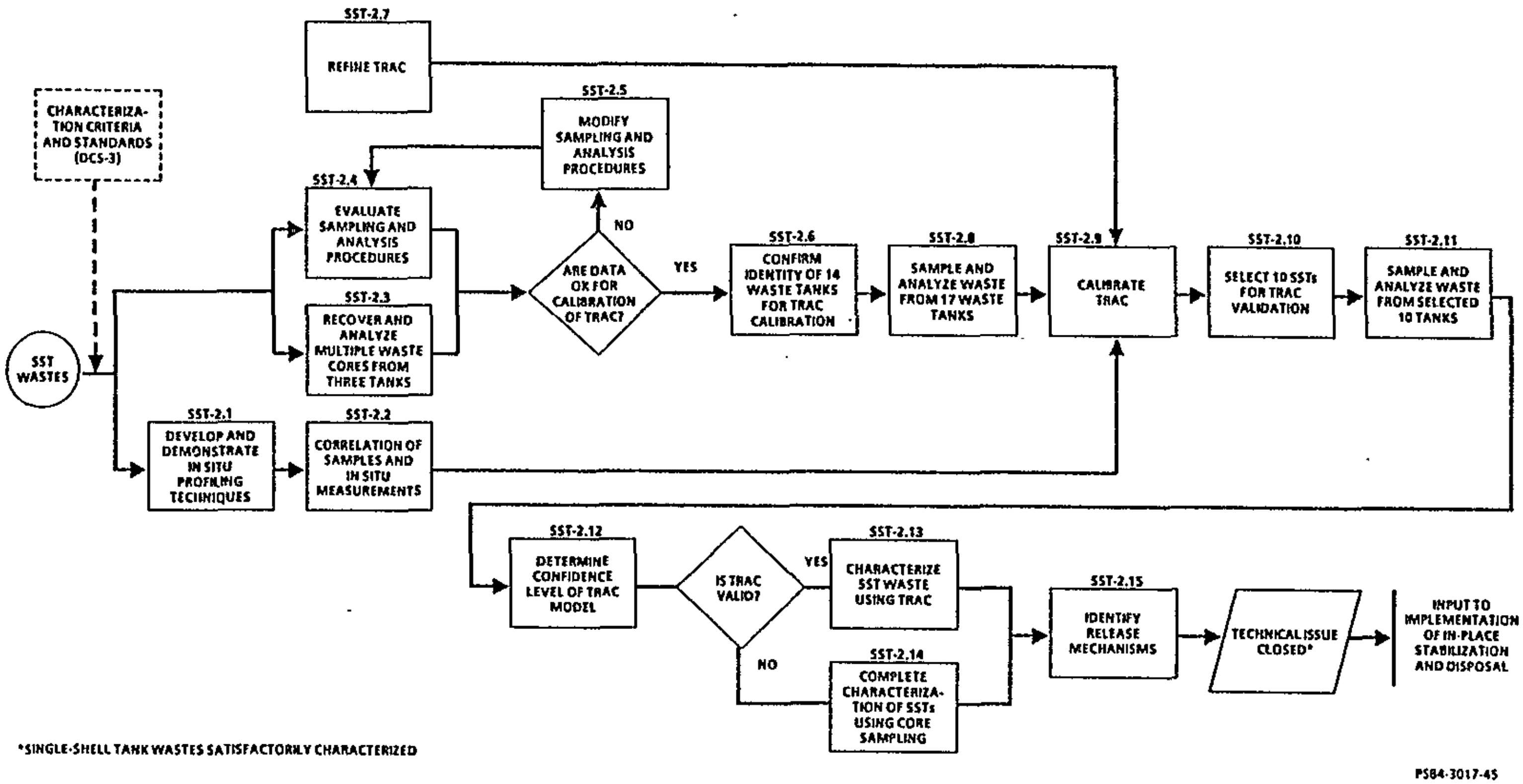


FIGURE V-3. Flow Diagram SST-2--Characterization.

Technical Issue SST-3

HEAT MANAGEMENT

Statement of Issue

The technical issue is: Will the temperature in any single-shell tank, after in-place stabilization and disposal including emplacement of protective barriers, exceed the permissible limit, and, if so, what, if any, technology must be developed and tested to satisfactorily manage (dissipate) radioactive decay heat in such tanks?

Elevated temperatures are observed in many SSTs due to heat generated as a result of radioactive decay. The temperature of SST wastes which have been stabilized and disposed will increase because of the insulating effects of the stabilization methods (dome fill and barriers). For most tanks the increased temperature will not be of concern. For some tanks, however, temperatures could rise to levels where there is concern about the thermal stability of the waste and/or the structural strength of tank components (e.g., concrete shell). Thus, this technical issue will, first of all, quantify permissible temperature limits in stabilized and isolated tanks and then, if necessary, develop methods or technology which can be used to satisfactorily dissipate decay heat.

Scope

The effects of heat generation in single-shell tank wastes will be evaluated and thermal management strategies and technology for the in-place stabilization and disposal of these wastes will be developed as part of closing this issue. The technology requirements include: determining heat loading limits under various conditions; identifying the tanks that exceed those limits; and determining required aging periods or developing methods to meet the thermal requirements.

Status

A parametric heat transfer analysis, which shows the general temperature response of key points in the waste and tank structure to variable heat loadings has been completed. Given a tank temperature limit, the heat loading limits for tanks with dry homogeneous waste may be determined from the results of this study. The study takes into account the different tank types and sizes, waste volumes, types of backfill material and the presence of engineered barriers.

Tasks to Close the Issue

The following tasks close the issue of heat management of SST wastes:

SST-3.1 Evaluate waste properties versus thermal effects

Perform laboratory tests with synthetic and actual wastes to evaluate thermal effects on the physical and chemical properties of the waste. ($190,000)

SST-3.2 Determine requirements to meet heat limit

Perform an engineering study of the strategy and technology development requirements to meet the heat content criteria for SSTs. ($40,000)

SST-3.3 Select methods to dissipate heat

Perform an engineering study to evaluate and select methods to dissipate heat in high heat SSTs. ($130,000)

SST-3.4 Test methods to dissipate heat

Perform laboratory and pilot-scale testing and demonstration of selected heat dissipation methods. ($480,000)

Flow Diagram

Figure V-4 illustrates the logical order of performing the tasks required to close the heat management technical issue for SST wastes.

Costs to Close the Issue

Manpower: $840,000
Materials: $210,000

Key Technical Decisions

- SST-3 (1): Do any single-shell tanks exceed the heat limit for disposal?

A "no" answer would eliminate the need to perform the following tasks:

- Select methods to dissipate heat. ($130,000)
- Test methods to dissipate heat. ($480,000)

The total savings would be $610,000.

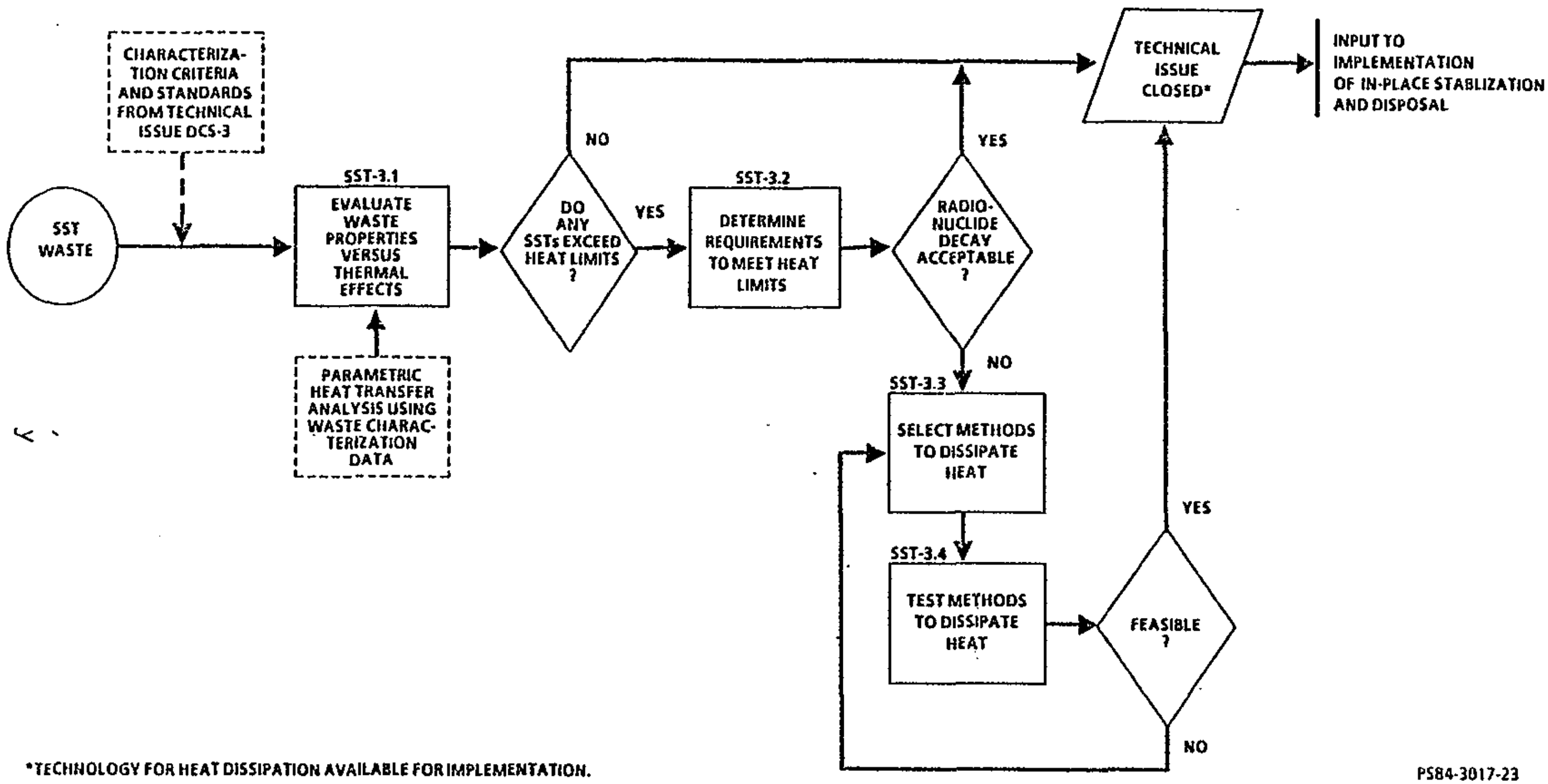


FIGURE V-4. Flow Diagram SST-3--Heat Management.

Technical Issue SST-4

COMPLEXANT EFFECTS

Statement of Issue

The technical issue is: Does the concentration of organic complexants in any single-shell tank exceed the permissible limit, and, if so, what technology must be developed to permit in-place stabilization and disposal of such single-shell tank waste?

The amount of organic complexants that can be tolerated in wastes in single-shell tanks, prior to in-place stabilization and disposal of such wastes, is the important technical issue considered here. Organic complexants of several types are present in varying amounts in all single-shell tank wastes; such complexants can significantly increase the mobility of radionuclides in the soil and, thus, their presence can significantly impact onsite stabilization and isolation of single-shell tank wastes.

Scope

Waste that contains high concentrations of organic complexants is currently stored in 12 single-shell tanks. Low levels of complexants have been detected in all the single-shell tank liquors sampled to date. Acceptable levels of organic complexants in tanks must be established based on an evaluation of the effects of complexants on radionuclide transport and disposal system performance. Then, if necessary, effective and economical methods of in-tank organic complexant destruction or other enhanced methods to meet performance requirements of onsite stabilization and isolation need to be determined.

Status

A preliminary investigation of potential complexant destruction processes has been undertaken to evaluate their adaptability to Hanford waste management requirements. Of the methods studied, ozonization at low temperatures has shown the most promise for effective, safe application to HSDW solutions. Ozonization however, is not practical for in-tank destruction of complexants. Laboratory studies of thermal degradation have shown incomplete destruction of complexants.

Tasks to Close the Issue

The following tasks close the issue of complexant effects in SST wastes:

SST-4.1 Evaluate needs and methods for In-Tank Complexant Destruction (ICD)

Perform an engineering study to evaluate need for and methods of in-tank destruction of complexants and recommend technology development requirements. ($140,000)

SST-4.2 Evaluate non-ICD methods

Perform an engineering study to evaluate methods, which do not involve complexant destruction, to enhance onsite stabilization and isolation performance for tanks containing large amounts of complexants. ($145,000)

SST-4.3 Test ICD methods

Conduct bench- and pilot plant-scale studies, if required, for evaluating methods and mechanisms for in-tank destruction of complexants. ($930,000)

SST-4.4 Demonstrate ICD method

Perform in-tank complexant destruction on actual SST waste. ($1,060,000)

SST-4.5 Test non-ICD methods

Conduct bench and pilot scale studies, if required, for evaluating methods and mechanisms for tank stabilization which do not involve complexant destruction. ($125,000)

SST-4.6 Demonstrate non-ICD method via field test

Field test methods which do not involve complexant destruction and methods for complexant destruction outside of tanks. ($470,000)

Flow Diagram

Figure V-5 illustrates the logical order of performing the tasks required to close the complexant effects technical issue of SST wastes.

Costs to Close the Issue

Manpower:	$2,870,000
Materials:	$315,000
Capital Equipment:	$245,000

Key Technical Decision

- SST-4 (1): Do any single-shell tanks exceed the limits for content of organic complexants?

A "no" answer would result in elimination of task combinations A or B as follows:

Combination A

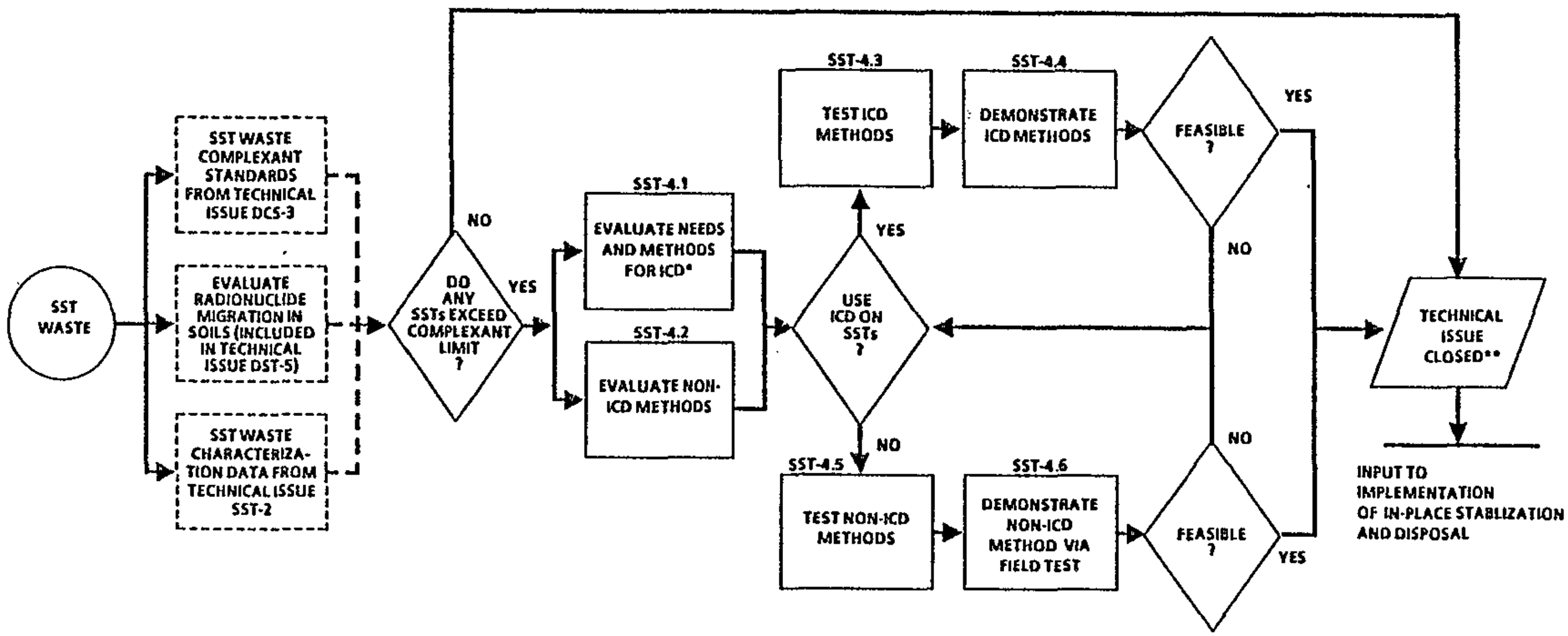
- Evaluate needs and methods for ICD. ($140,000)
- Evaluate non-ICD methods. ($145,000)
- Test ICD methods. ($930,000)
- Demonstrate ICD method. ($1,060,000).

The total savings would be $2,280,000.

Combination B

- Evaluate needs and methods for ICD. ($140,000)
- Evaluate non-ICD methods. ($145,000)
- Test non-ICD methods. ($125,000)
- Demonstrate non-ICD via field test. ($470,000)

The total savings would be $880,000.



*IN-TANK COMPLEXANT DESTRUCTION.
**TECHNOLOGY FOR DESTROYING COMPLEXANTS IS AVAILABLE FOR IMPLEMENTATION.

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FIGURE V-5. Flow Diagram SST-4--Complexant Effects.

Technical Issue SST-5

MOISTURE EFFECTS

Statement of Issue

The technical issue is: Does the amount of moisture in any single-shell tank (after jet well pumping) exceed the permissible limit for in-place stabilization and disposal and, if so, what technology must be developed to accomplish further drying of single-shell tank wastes?

Prior to in-place stabilization and disposal of SST wastes, it may be necessary to reduce their moisture content below levels achieved during jet pumping. Excessive moisture could reduce the stability of the SST wastes to levels where the probability of undesirable release of radionuclides to the environment is high enough to preclude implementation of in-place stabilization and disposal. The thrust of this technical issue is to determine the need for further waste drying and, if required, to develop and demonstrate satisfactory drying technology.

Scope

The scope of activities involved in this issue includes determination of the need for further waste drying based on waste properties as a function of moisture content and on the performance requirements of the onsite stabilization and isolation system. Determination of the need for further drying will take into account possible increases in potential for occurrence of exothermic reactions. Following the definition of need and the identification of acceptable moisture levels, in-tank drying technology will be evaluated and, if needed, developed and demonstrated.

Status

The current jet pumping program is the most efficient method for removing large quantities of interstitial liquids from tank wastes. Earlier preliminary studies have evaluated additional methods for further waste drying including direct resistance drying, radio frequency drying, electro-osmosis, and hot air drying. Proof-of-principle tests of in-tank radio frequency drying have been conducted in the laboratory. Further studies to identify optimal frequencies for drying thick waste layers are being completed.

Tasks to Close the Issue

The following tasks close the issue of moisture content in SST wastes:

SST-5.1 Determine waste stability versus water content

Perform laboratory studies to determine the stability of waste in SSTs as a function of moisture content. ($100,000)

SST-5.2 Evaluate deliquescent properties of waste

Perform calculations with associated (as needed) field tests to determine and evaluate the deliquescent properties and resaturation rates of wastes as a function of time. ($200,000)

SST-5.3 Evaluate techniques to meet moisture limits

Perform an engineering study to define and evaluate cost-effective techniques to meet moisture content limits for SSTs. ($105,000)

SST-5.4 Develop moisture removal methods

Perform bench- and pilot-scale studies on moisture removal methods identified as being cost effective. ($1,060,000)

SST-5.5 Demonstrate moisture removal on a SST

Perform in-tank drying demonstrations on actual SST waste. ($1,270,000)

Flow Diagram

Figure V-6 illustrates the logical order of performing the tasks required to close the moisture effects technical issue for SST wastes.

Costs to Close the Issue

Manpower:	$2,740,000
Materials:	$200,000
Capital Equipment:	$235,000

Key Technical Decision

- SST-5 (1): is it necessary to remove moisture from any single-shell tank after jet well pumping and prior to onsite stabilization and isolation?

A "no answer would eliminate the need to perform the following tasks:

- Evaluate techniques to meet moisture limits. ($105,000)
- Develop moisture removal methods. ($1,060,000)
- Demonstrate moisture removal on an SST. ($1,270,000)

The total savings would be $2,440,000.

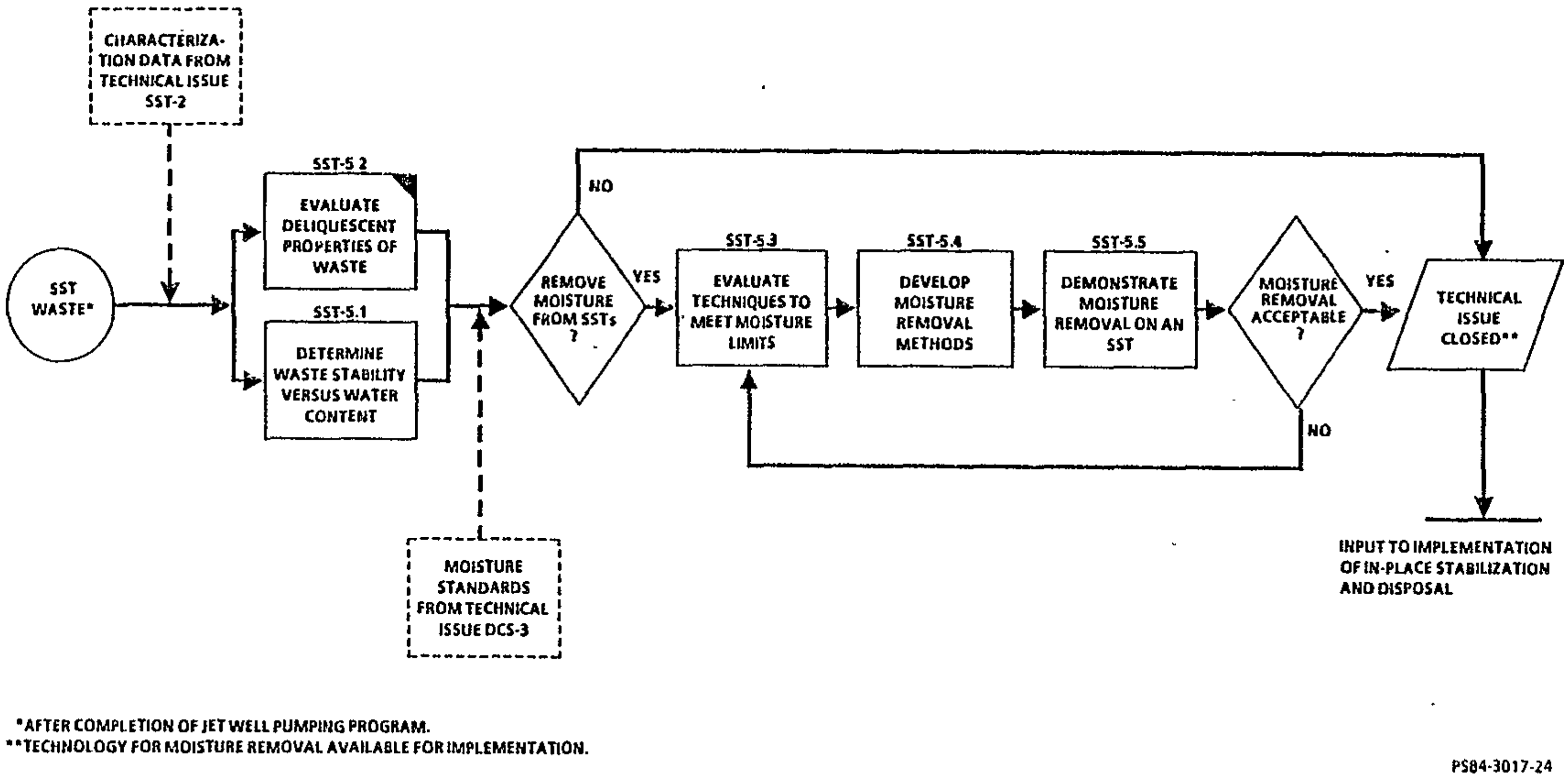


FIGURE V-6. Flow Diagram SST-5--Moisture Effects.

Technical Issue SST-6

DOME FILL

Statement of Issue

The technical issue is: What are satisfactory procedures for filling major void spaces in single-shell tanks?

Satisfactory in-place stabilization and disposal of wastes in SSTs requires that the major void space in the tanks be filled to minimize the effects of ultimate subsidence which could destroy the surface engineered barrier. This issue addresses the several aspects of developing technology for filling tank void spaces prior to placing engineered barriers over the SSTs.

Scope

The scope of technology development for filling domes of single-shell tanks must address the following areas:

- Evaluation and selection of dome fill materials.
- Development and testing of methods and equipment for filling void spaces using previously selected materials.
- Demonstration of dome filling technology on an actual single-shell tank(s) containing radioactive wastes.
- Response of waste to fill materials.

Status

An engineering study which proposed and outlined a plan for the demonstration of in-place stabilization and disposal of a single-shell tank has been completed. Dome fill materials and equipment were evaluated in this study; the use of basalt gravel as the dome fill material to be installed with a slinger was recommended. An engineering study which provides the preconceptual design for a simulated waste tank to test dome fill equipment and methods using selected materials has also been finished.

A monitoring plan has been prepared that establishes the basis for a monitoring program to develop a data base on the performance of waste/fill material. This data base will be used to fully understand and optimize the performance of the disposal method. The design criteria have been prepared for the equipment to be used during the domefill of the 241-TY tank farm. Design criteria are presented for the selection of fill materials, placement of fill materials, and monitoring of the waste/fill performance.

Test plans have been prepared that describe the laboratory evaluation of the physical and chemical interactions between the proposed fill material and the waste.

Tasks to Close the Issue

The following tasks close the issue of dome fill of SSTs:

SST-6.1 Conduct fill material settling/consolidation studies

Conduct bench-scale studies to determine fill material settling rates and rates of consolidation as a function of the physical, chemical, and thermodynamic properties of the waste. ($70,000)

SST-6.2 Determine fill material thermal characteristics

Conduct bench-scale studies to determine thermal characteristics of candidate dome fill materials. ($140,000)

SST-6.3 Determine instrumentation requirements for dome filling

Determine instrumentation monitoring requirements for dome filling. Select and test instrumentation monitoring system. ($80,000)

SST-6.4 Conduct fill material/waste interaction tests

Conduct a series of laboratory and pilot-scale studies to examine tank system interactions between fill materials, waste, moisture, and chemical components. ($400,000)

SST-6.5 Conduct dome filling equipment tests

Using selected fill materials, design, procure and construct a mock waste tank, and test the dome fill slinger. ($205,000)

SST-6.6 Demonstration of SST dome fill

Design and develop equipment, write procedures, and write safety and environmental documentation to be used in a full-scale demonstration of dome filling. Conduct the demonstration and monitor the results for a five-year period (includes monitoring after barrier placement). ($3,990,000)

SST-6.7 Develop SST disposal plan

Develop a plan which provides for disposal of all 149 single-shell tanks. This plan should provide a logical schedule for working off the tanks as they are isolated and as the remaining contents decay to appropriate levels for in-place disposal. ($300,000)

SST-6.8 Develop alternative filling methods

If necessary, develop and test alternative dome filling materials or procedures. Alternatives may be considered for tanks containing higher levels of heat, complexants, moisture, and waste. ($600,000)

Flow Diagram

Figure V-7 illustrates the logical order of performing the tasks required to close the dome fill technical issue for SSTs.

Costs to Close the Issue

Manpower:	$5,780,000
Materials:	$980,000
Capital Equipment:	$700,000

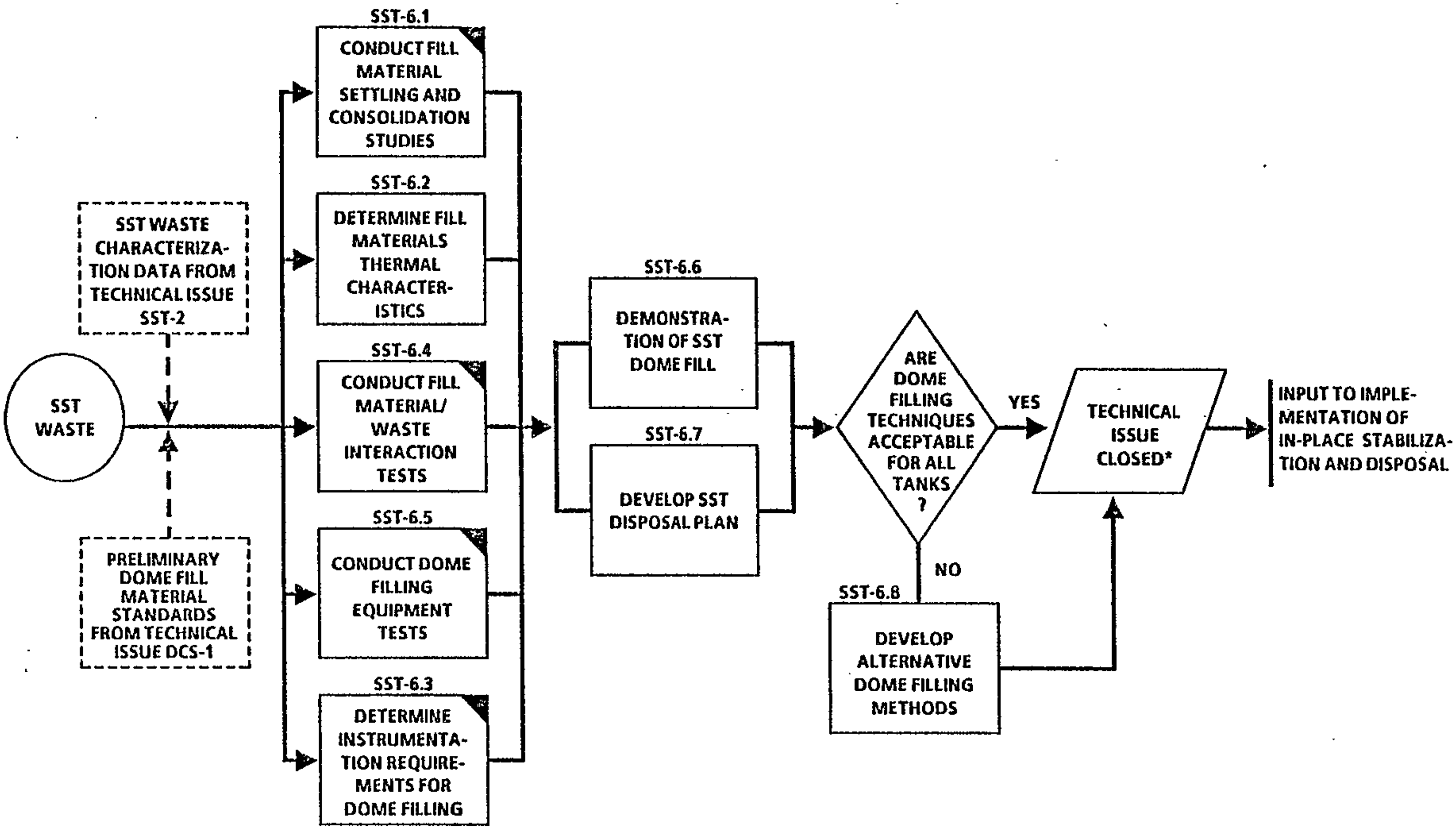
Key Technical Decision

- SST-6 (1): Are dome filling techniques acceptable for all tanks?

A "yes" answer would eliminate the need to perform the following task.

- Develop alternative dome filling methods. ($600,000)

The total saving would be $600,000.



*TECHNOLOGY FOR DOME FILL OF SINGLE-SHELL TANKS IS AVAILABLE.

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FIGURE V-7. Flow Diagram SST-6--Dome Fill.

Technical Issue SST-7

PROTECTIVE BARRIERS

Statement of Issue

The technical issue is: What technology efforts must be expended to select, evaluate and test materials for and methods of emplacement of protective barriers which must be placed over in-place stabilized and disposed waste disposal locations?

Placement of protective barriers to control potential radionuclide transport, as well as radiation exposure to the inadvertent intruder, is an essential part of in-place stabilization and disposal of wastes which are near the surface. Site control is necessary for periods ranging from hundreds of years to beyond 10,000 years without the need for active monitoring, maintenance, or institutional controls. The technical issue involved is to select, evaluate and demonstrate barrier materials, barrier systems, and emplacement methods which meet all requirements (DOE, EPA, Washington State).

Scope

Protective surface barriers have been identified as integral components of in-place stabilization and disposal disposal systems for single shell tanks and contaminated soil and solid burial waste sites. Five phases of technology development are necessary before surface barrier construction can become operational: (1) technical assessment using simulation models to help select appropriate designs and to assess long-term effectiveness/performance of barriers; (2) assessment of natural analogs; (3) field lysimeter test facility; (4) barrier field testing including biobarriers and surface stabilization; and (5) in some cases, testing of barriers on actual waste sites and facilities.

Simulation models will be used to help select appropriate barrier designs to define field test data requirements and to assess the potential effectiveness/performance of the barrier systems. Based on the information obtained from the simulations and from the natural analog, barrier systems and materials will be selected for field testing. A lysimeter field test facility will also be established to more closely monitor and evaluate the behavior of water transport in the various barrier systems that will also be applied in the Protective Barrier Test Facility (PBTF). The PBTF has been established for the field scale design, construction, and performance monitoring of selected barrier types. Engineering specifications including design, construction, and material specifications will be developed. Relatively short term barrier performance monitoring will support predictive and simulation modeling of long-term barrier performance.

Another performance assessment approach involves the examination of natural formations and engineered earthen structures which are analogous to the barrier designs and which have existed for extended times. The qualitative information obtained from this assessment can be used to help design natural barrier systems. As an example, sediments deposited during Pleistocene catastrophic flooding of the Columbia Basin afford a unique opportunity to evaluate the performance of proposed barrier designs which are intended to last up to 10,000 years.

The results of model simulations, analog assessment, and PBTF activities will support the design, construction, and performance assessment of surface barriers to be demonstrated on various existing waste sites. Surface barrier technology will be integrated with other onsite stabilization and isolation disposal methods and demonstrated at a single-shell tank farm, a contaminated soil site, and a solid waste burial site.

Tasks to Close the Issue

The following tasks close the issue of protective surface barriers.

SST-7.1 Complete natural analogs studies

Complete analyses of selected natural analog sites for the multi-layer, massive rock, massive soil, and massive soil with rock armor barrier types. Also assess erosion processes and rates and determine rooting characteristics. Document results and conclusions of the regional survey and detailed material analog site characterizations. ($305,000)

SST-7.2 Evaluate physical stability of barriers

The physical stability requirements for an protective barrier will be established. Criteria will include durability and test specification as well as considerations of subsidence, erosion, and susceptibility. The stability of the barrier systems and materials will be evaluated including the effects of secondary consolidation that could result from the barrier cover load. Subsidence and differential settling can also be expected, depending on the construction method, nature of waste, etc.; therefore, the physical stability of the barriers will be evaluated. ($1,000,000)

SST-7.3 Identify biointrusion control techniques

The requirements for protection against biological intrusion of plants and animals will be reviewed. This will include reviewing plant rooting characteristics (the maximum plant rooting depths), animal burrowing depths, and methods to control biointrusion. Biointrusion potential will be evaluated, primarily using existing site data. ($255,000)

SST-7.4 Complete erosion control and stability studies

The requirements for the long-term protection of the surface barrier will be reviewed. This will include primarily surface (wind and water) erosion and a brief review of potential geomorphologic hazards. Methods to protect the surface will be assessed including the use of vegetation. Surface stabilization test plots will be installed as part of the PBTF and field lysimeter tests. ($980,000)

SST-7.5 Select and optimize more promising barriers for field test evaluation

Model simulations (of erosion, water transport, biotic transport stability, etc.) will be used to help select and optimize appropriate barrier designs for field evaluation and to determine what field test data are needed for model verification (define data requirements). ($150,000)

SST-7.6 Design barriers for field evaluation

Based on the results of the model simulations and physical stability evaluation, the most promising barrier systems will be designed for field evaluation. Design considerations will include potential for control against infiltration, biotic intrusion, and human intrusion. Evaluate potential sources of barrier materials as an input to barrier design efforts. ($90,000)

SST-7.7 Construct and monitor barrier test plots at the Protective Barrier Test Facility

Install selected barrier test plots using alternative cover designs including surface stabilization at PBTF and continue monitoring and evaluation of effectiveness. ($600,000)

SST-7.8 Construct and monitor barriers at Controlled Field Lysimeter Test Facility (CFLTF)

A lysimeter field test facility will be established to more closely monitor and evaluate the water transport characteristics of the barrier systems prior to full-scale testing. A controlled test environment will be used to help validate the simulation models. ($855,000)

SST-7.9 Apply monitoring data to verify simulation model

Selected data from the field tests will be used to verify the simulation model. Data from various study sites at Hanford, including PBTF and selected biointrusion and long-term protection studies, will be used in the model simulations. ($405,000)

SST-7.10 <u>Assess effects of expected climatic changes and barrier defects</u>

The effect of climate changes on barrier system performance will be modeled. The quantity and distribution of precipitation will be considered. The effects of barrier defects will be modeled to determine their consequence. Engineered Barrier Test Facility and field lysimeter test facility monitoring data will be analyzed and use for simulation model validation. ($53,000)

SST-7.11 <u>Synthetic Tank Waste Barrier Tests</u>

Past studies have shown a potential for reduced barrier performance due to diffusion, dissolution, and settlement of waste materials below subject barriers. This task activity includes laboratory and field investigations of mechanisms that may significantly reduce the effect of protective barriers. This task will involve design and construction of field simulation modules to test mass transfer and geotechnical properties for tank waste in relation to barrier performance.

The scope of this task also includes analysis of the surficial area of tanks expected to fail as a function of time. Surficial failure will be related to existing data for corrosion and structural failure events (Defigh-Price 1982, Dahlke and DeFigh-Price 1983), tank contents, soil moisture, tank design, etc. ($995,000)

SST-7.12 <u>Develop engineering specifications and design guide</u>

Results for the PBTF and CFLTF will be used to define design, procedures, and material specifications for the most promising barrier systems. A design guide will be prepared to help in the installation of the barriers. ($105,000)

SST-7.13 <u>Design barrier for SST farm</u>

Prepare detailed designs for surface barriers to be implaced in conjunction with the SST disposal demonstration. (Cost included in SST-7.14.)

SST-7.14 <u>Demonstration of protective barriers on SST farm</u>

Perform tank-scale demonstration on SST farm of protective barriers. Monitoring and analysis of data is included in SST-6.6. ($305,000)

SST-7.15 <u>Design CSS and SWB barrier</u>

Prepare detailed designs and procedures for implacement of surface barriers to be constructed at both a CSS and a SWB site. ($210,000)

SST-7.16 <u>Field-scale demonstration of CSS and SWB barriers</u>

Place a prototype surface barrier (including instrumentation for monitoring) at a CSS site and an SWB site; monitor barrier performance and analyze monitoring data. ($600,000)

Flow Diagram

Figure V-8 illustrates the logical order for performing the tasks required to close the engineered barriers technical issue.

Tasks to Close the Issue

Manpower:	$6,910,000
Materials:	$2,020,000
Capital Equipment:	$155,000

Key Technical Decision

- SST-7 (1): Is a field-scale demonstration of engineered barrier technology for SWB and CSS sites necessary?

A "no" answer would eliminate the need for the following task:

- Field scale demonstration of CSS and SWB barriers. ($600,000)

Total cost savings would be $600,000.

Bibliography

DeFigh-Price, C., (1982), <u>Status of Tank Assessment Studies for Continued In-Tank Storage of Hanford High-Level Defense Waste</u>, RHO-RE-ST-4 P, Rockwell Hanford Operations, Richland, Washington.

Dahlke, H. J. and C. DeFigh-Price (1983), <u>Tank Assessment Studies for Continued In-Tank Storage of Hanford Defense Wastes</u>, RHO-RE-ST-10 P, Rockwell Hanford Operations, Richland, Washington.

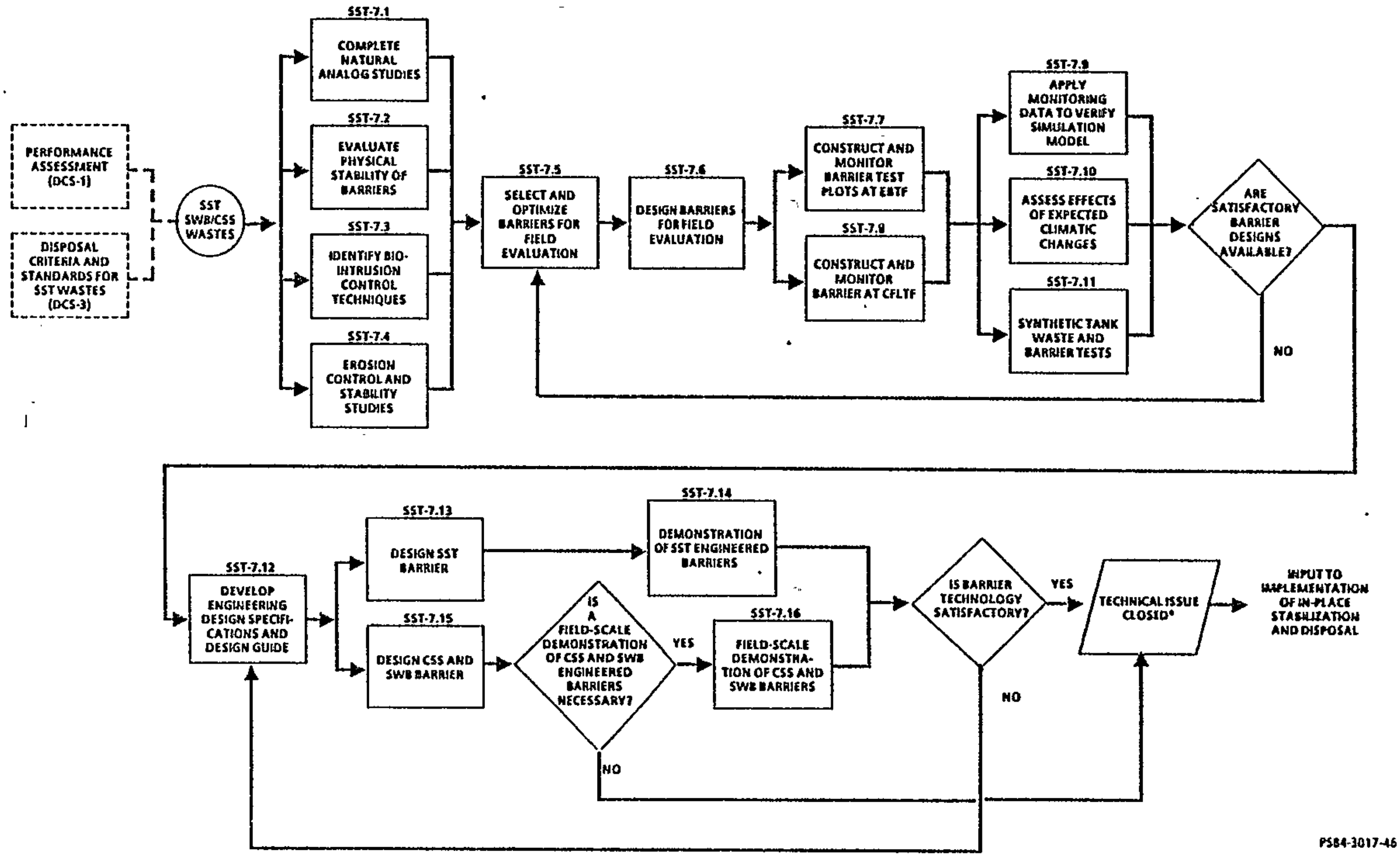


FIGURE V-8. Flow Diagram SST-7--Protective Barriers.

Technical Issue SST-8

MARKERS

Statement of Issue

The technical issue is: Given that all locations where various types of HSDW are in-place stabilized and disposed will need to be identified by appropriate markers, what are the technology requirements to specify marker needs, locations, properties, materials and emplacement procedures?

Scope

The scope of this issue includes:

- Determination of the number and types of in-place stabilized and disposed sites for which some kind of marker is needed.
- Determination of the optimum spacing and placement of markers in relation to barrier systems.
- Identification of marker materials, messages, and configurations for subsurface and surface markers.
- Testing of selected markers under conditions to be found in the environment. Testing may involve these components:
  - Accelerated testing in environmental chambers.
  - Examination of archaeological evidence regarding durability and of materials.
  - Field placement and monitoring of full-scale markers.

Status

Preliminary studies have been performed on alternative marker materials and configurations for both surface and subsurface markers. Preliminary cost estimates have been prepared for these alternatives. Potential disposal sites to be marked have been selected.

Tasks to Close the Issue

The following tasks are required to close the issue of site markers for onsite stabilized and isolated disposal sites:

SST-8.1 Choose disposal sites to be marked (Completed)

Conduct cost-risk analyses to establish which in-place stabilized and disposed sites need to be identified by markers. Recommend marker spatial arrangement. (Completed in FY 1984)

SST-8.2 Evaluate ancient durable materials (Completed)

Conduct a literature review and evaluate the use of ancient durable materials such as pottery, stone works, monoliths, burial chambers, etc. for markers. (Completed in FY 1984)

SST-8.3 Evaluate alternative materials, configurations, and messages (Completed)

Perform additional engineering studies that address alternative materials, configurations, and messages for surface and subsurface markers. Attention should be focused on natural or manmade materials known to have low intrinsic human value but great durability as evidenced by archaeological findings or accelerated testing. (Completed in FY 1984)

SST-8.4 Test candidate marker materials

Test durability of marker materials as a function of thermal cycling, chemical assault (i.e., acid rains), freeze-thaw cycling, and wind and water scour. ($70,000)

SST-8.5 Select materials, configurations, and messages

Evaluate available data on materials, configurations, and messages for markers and select a marker design. ($35,000)

SST-8.6 Conduct a field-scale confirmation of marker technology

Construct markers from marker design information and conduct a field-scale confirmation of marker emplacement technology. Provide long-term monitoring of marker test pieces. ($95,000)

Flow Diagram

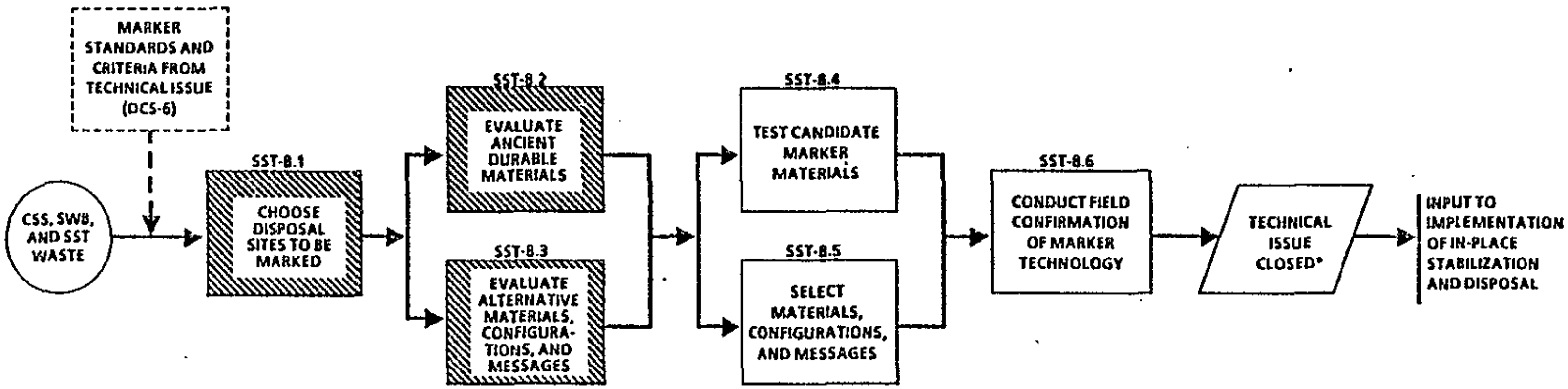
Figure V-9 illustrates the logical order for performing the tasks required to close the markers technical issue for SSTs, CSSs, and SWBs.

Costs to Close the Issue

Manpower: $200,000
Materials: $20,000

Key Technical Decisions

No key technical decisions were identified as being required to close the technical issue of markers.



*TECHNOLOGY FOR MARKERS AVAILABLE FOR IMPLEMENTATION.

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FIGURE V-9. Flow Diagram SST-8--Markers.

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VI. CONTAMINATED SOIL SITES

A. REFERENCE DISPOSAL PLAN

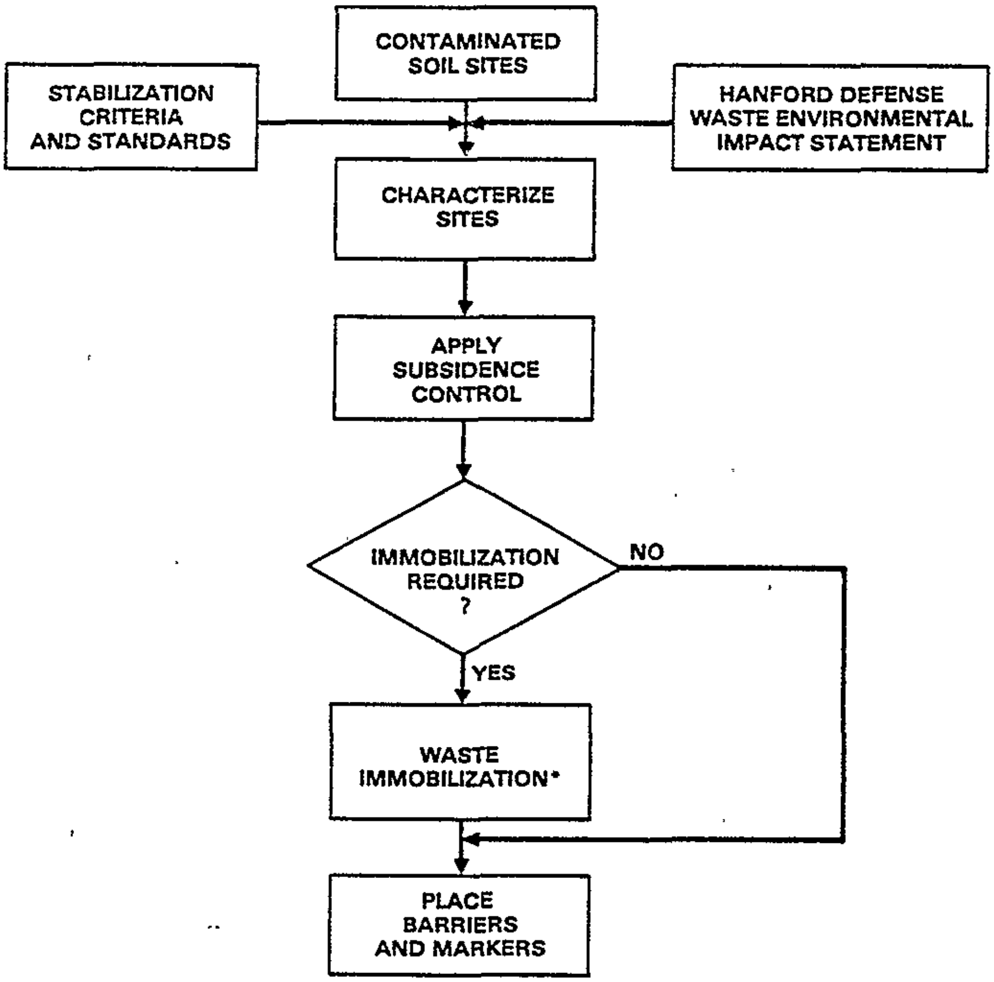
The reference plan for remedial action to enhance long-term stability of disposed contaminated soil sites (CSS) is shown in Figure VI-1. Table VI-1 lists significant dates associated with disposal of CSS waste.

B. SCHEDULE

Schedules for resolving the technical issues are shown in Figure VI-2.

C. COST SUMMARY

Table VI-2 summarizes the costs (escalated through FY 1987) associated with development of technology required to close the CSS technical issues.



*IN SOME SITES, IMMOBILIZATION OF TRU COMPONENTS AND/OR CHEMICAL HAZARDOUS WASTES MAY BE REQUIRED (FOR EXAMPLE, IN-SITU VITRIFICATION OR GROUT INJECTION)

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FIGURE VI-1. Reference Plan for In-Place Stabilization of Disposed Contaminated Soil Sites.

TABLE VI-1. Significant Hanford Waste Management Dates--
Contaminated Soil Sites.

FY 1986-1987	Conduct tests of in situ vitrification of TRU contaminated soil site
FY 1988	Complete 200 Area crib interim surface stabilization program
FY 1991-2010	Conduct contaminated soil site in-place stabilization operations

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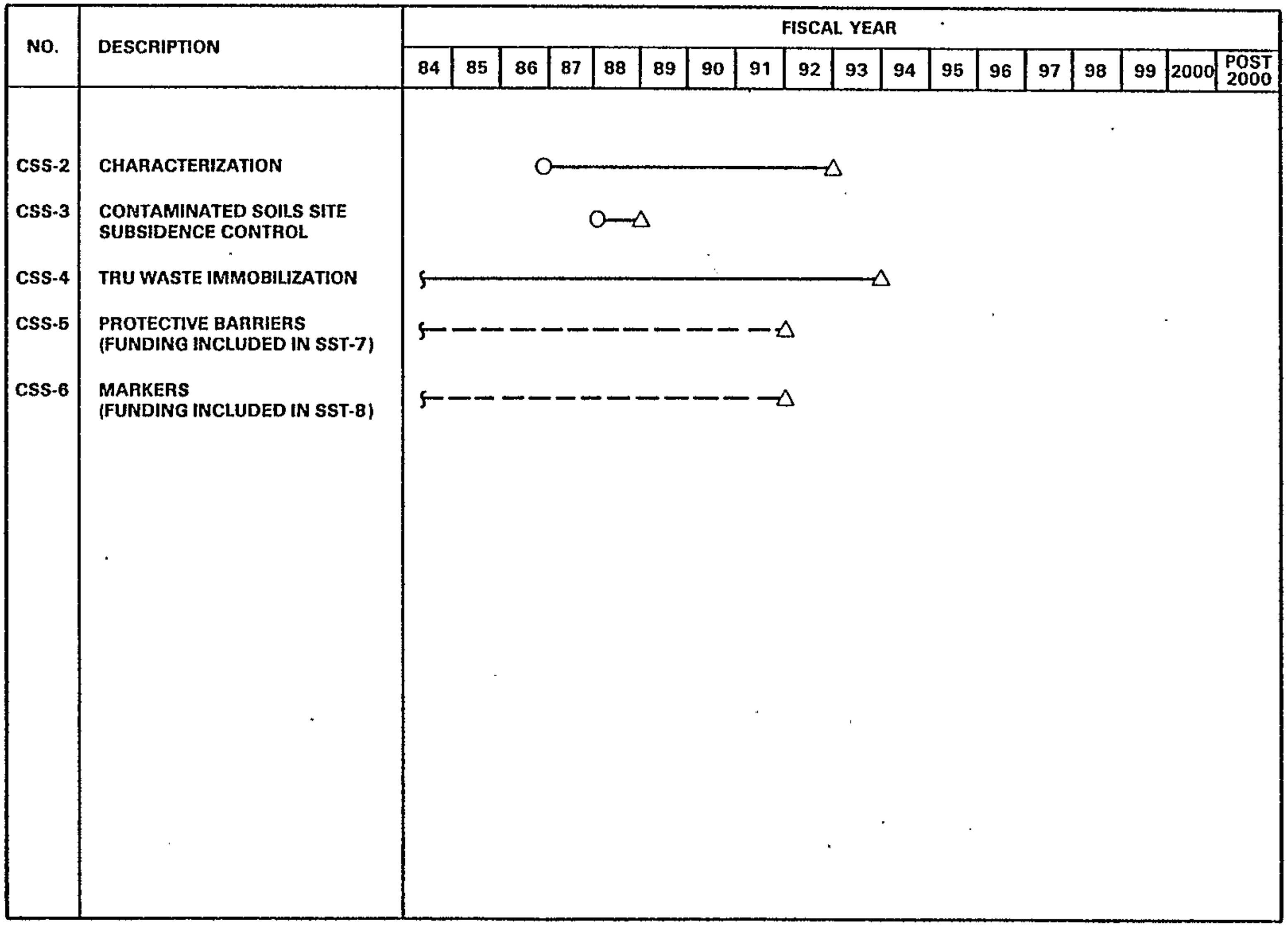

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FIGURE VI-2. Schedules for Resolving CSS Technical Issues.

TABLE VI-2. Estimated Technology Development Costs--Contaminated Soil Sites.

Technical issue		Estimated costs ($1,000)			
Identification symbol	Title	Manpower	Material	Capital equipment	Total
CSS-1	Interim Management	a	a	a	a
CSS-2	Characterization	$ 3,120	$ 60	$150	$3,330
CSS-3	Contaminated Soil Site Subsidence Control	145	10		155
CSS-4	TRU Waste Immobilization	8,780	2,510[b]		11,300
CSS-5	Protective Barriers	b	b	b	b
CSS-6	Markers	c	c	c	c
	TOTAL (rounded)	$12,000	$2,580	$150	$14,800

[a]Costs for interim management shown in Appendix B.

[b]Costs included in those for Technical Issue SST-7 (Table V-2).

[c]Costs included in those for Technical Issue SST-8 (Table V-2).

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TECHNICAL ISSUE CSS-1

INTERIM MANAGEMENT

For reasons stated on page I-4, this Technical Issue is now addressed in Appendix B.

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Technical Issue CSS-2

CHARACTERIZATION

Statement of Issue

The technical issue is: What data are required to satisfactorily characterize CSSs and waste ponds to permit additional or remedial action to enhance the long-term stability of these wastes?

Contaminated soil and waste pond sites must be characterized to: (1) estimate the potential for undesirable site subsidence and to provide data for developing cost-effective stabilization strategies; (2) support required safety (criticality, radiological, and industrial) analyses; (3) satisfy applicable laws and regulations; and (4) address environmental and effluent control concerns. Because of the large number of sites which must be characterized, inexpensive and reliable methods of data collection and analysis must be developed.

Scope

Site characterization is likely to require the collection of data in the following areas:

- Waste site location and subsurface structures (including voids)
- Radionuclide and chemical waste distribution and inventory
- Waste pond influent inventory
- Hazardous waste distribution and inventory (organic chemicals, solvents, toxic inorganics)
- Release mechanisms
- Validation of TRU sites
- Identification of nonwaste-site features such as crossover lines, etc.
- Local environmental characteristics and parameters.

A variety of techniques such as checks of historical records, physical sampling, down-hole measurements (e.g., neutron interrogation, etc.) and remote sensing can be usefully employed in characterizing a CSS. Means whereby costs of characterizing a CSS can be minimized include: (1) determination of minimum characterization data requirements to satisfy safety, legal, environmental, and engineering (stabilization) needs;

(2) correlation of characterization parameters with available site parameters; and (3) development of required characterization technology. The discussion of the latter item, provided in Technical Issue SWB-1, applies to this technical issue as well.

Status

A reverse well, a French drain, and a tank leak have all previously been characterized (Smith, 1980; Price, et al., 1979; Van Luik and Smith, 1980; Routson et al., 1979) by means of physical sampling, waste disposal records, and down-hole radioactivity measurements.

Statistically designed sampling methods and state-of-the-art analytical techniques are currently being applied to the characterization of waste pond sediments for the presence of regulated or potentially regulated organic constituents of hazardous wastes.

There remains a need for characterization methods for surface and near-surface areas overlying a CSS with emphasis on biologic and physical pathways which could result in redistribution of radionuclides.

Tasks to Close the Issue

The following tasks close the issue of characterization of contaminated soil and waste pond sites:

CSS-2.1 Perform an engineering requirements analysis

Perform an engineering study, using proper attention to the quality assurance requirements, to evaluate the minimal stabilization, safety analysis, legal, environmental and effluent control input requirements needed from site characterization, as well as the needed accuracy of each of these requirements. (Funded under SWB-1)

CSS-2.2 Develop characterization methodology

Characterization methods not already available will be developed, integrated with existing methods, and adapted to meet the engineering requirements for isolation and stabilization. Methods will be developed for measuring organic and inorganic toxicants. Optimal field sampling designs to characterize surface and near-surface areas overlying a CSS will be developed. Cost effective alternatives to expensive laboratory analyses of all samples (e.g., double sampling, compositing, etc.) will be specifically tailored to CSS requirements. ($190,000)

CSS-2.3 <u>Characterize a selected crib site with emphasis on surface and near-surface distribution of radionuclides</u>

Characterize a generic crib site with emphasis on surface and near-surface distribution of radionuclides. A crib site will be chosen which has shown a past history of radionuclide movement to the surface. Sampling methods for biotic pathways, near-surface instrumentation, and vadose zone characterization will be emphasized. ($480,000)

CSS-2.4 <u>Identify Release Mechanisms</u>

Mechanisms controlling the release of hazardous chemicals and radionuclides from contaminated soil sites will be identified. Releases will be related to site inventories, construction and operational histories, local hydrogeology, and soil properties. Models that quantify the release from individual sites and groups of sites will be developed as input to performance assessments. This task will serve as input to DCS-1.4, -1.6, and -1.9. (Funded under SWB-1.6)

CSS-2.5 <u>Complete characterization of sites</u>

As necessary, complete characterization of contaminated soil sites and waste pond sites based on sound statistical designs and with a recognition of geochemical and transport modeling data needs. ($2,450,000)

Flow Diagram

Figure VI-3 illustrates the logical order of performing the tasks required to close the characterization technical issue for CSS.

Costs to Close the Issue

Manpower:	$3,120,000
Materials:	$60,000
Capital Equipment:	$150,000

Key Technical Decisions

No key technical decisions were identified as being required to assure the characterization of CSS.

Bibliography

Price, S. M., R. B. Kasper, M. K. Additon, R. M. Smith, and G. V. Last (1979), Distribution of Plutonium and Americium Beneath the 216-Z-1A Crib: A Status Report, RHO-ST-17, Rockwell Hanford Operations, Richland, Washington.

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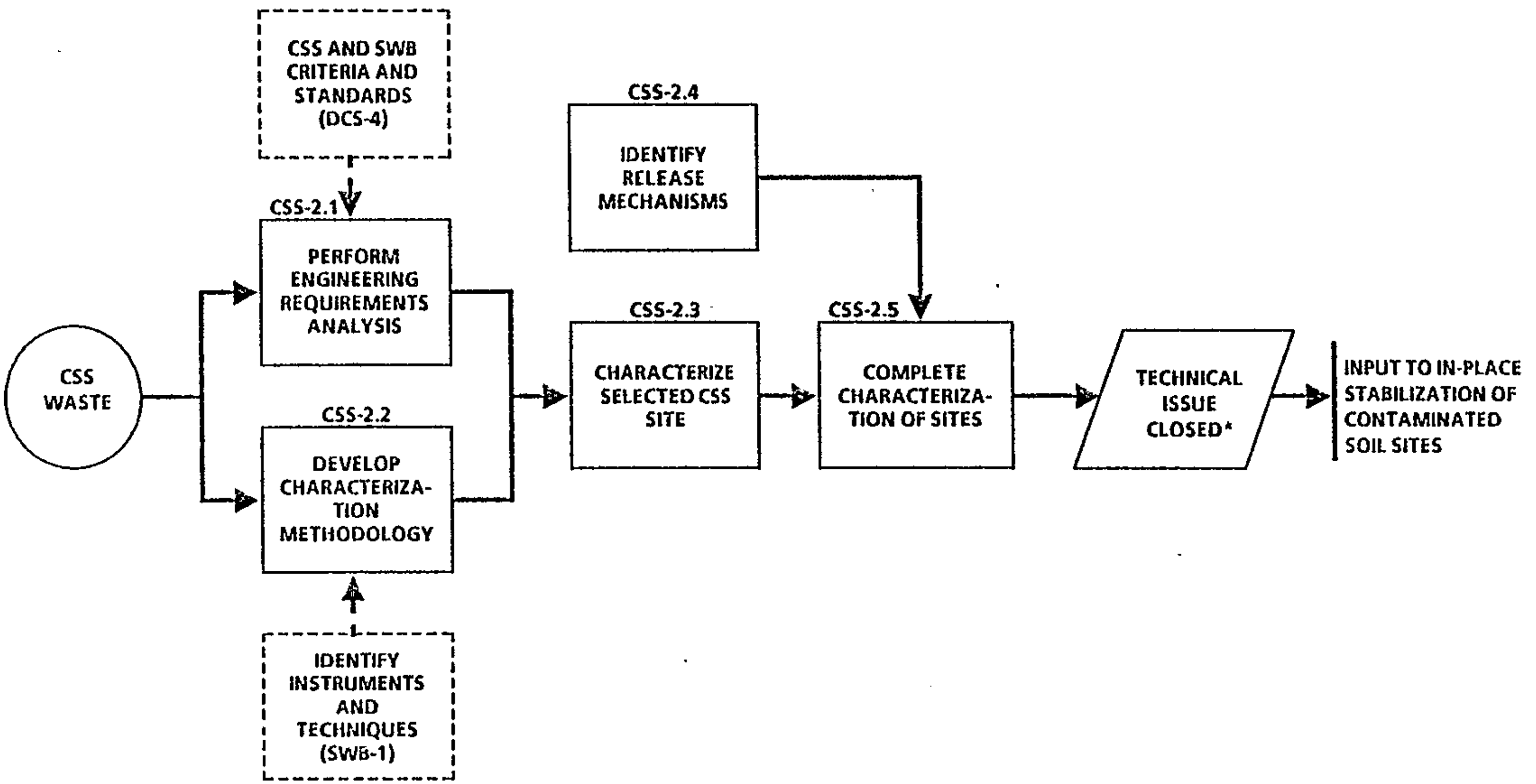

*CHARACTERIZATION OF CONTAMINATED SOIL SITES IS ADEQUATE.

PS84-3017-20

FIGURE VI-3. Flow Diagram CSS-2--Characterization.

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Technical Issue CSS-3

CONTAMINATED SOIL SITE SUBSIDENCE CONTROL

Statement of Issue

The technical issue is: Which, if any, contaminated soil sites contain void space which must be filled prior to their in-place stabilization and isolation, and what kind of void fill technology needs to be developed and tested?

Unless remedial action is taken, certain contaminated soil sites used for the ground disposal of waste solutions containing low levels of radioactivity may subside after in-place stabilization and isolation. Of particular concern are cribs with wooden underground structures and those sites with underground catch tanks and reverse wells. Methodology for filling or collapsing voids in these cribs, catch tanks and reverse wells to prevent subsidence and possible release of unacceptable amounts of radioactivity must be developed and demonstrated.

Scope

Low-level liquid radioactive wastes were disposed of in cribs beginning in 1946. Originally, cribs were rectangular structures constructed by crossing wooden timbers on alternate sides. Over time, these wooden structures have degraded and the voids which formed have caused significant soil subsidence. Modern-day cribs consist of tile pipe surrounded by carefully packed coarse gravels; these structures are backfilled to the soil surface according to strict specifications. No subsidence problems are expected for these latter-day cribs. Some contaminated soil sites also have underground catch tanks; these sites may also undergo subsidence. Methods and materials for filling or collapsing contaminated soil site voids to prevent unacceptable subsidence must be devised and demonstrated.

Status

No work on this specific issue has been performed. However, technology for treating voids in caissons and solid waste burial grounds is also relevant to this issue.

Tasks to Close the Issue

The following tasks close the issue of contaminated soil site void fill:

CSS-3.1 Devise and evaluate methods for treating voids

Devise and evaluate methods for treating voids in wooden cribs, catch tanks, and reverse wells; recommend preferred methods and determine if field demonstration is necessary. (Funded under SWB-2.5)

CSS-3.2 Conduct field demonstration

If necessary, design and conduct field demonstration of the recommended method for treating for voids in cribs; evaluate and document results. Determine applicability for the SWB sites. ($145,000)

Flow Diagram

Figure VI-4 illustrates the logical order of performing the tasks required to close the contaminated soil site void fill issue.

Costs to Close the Issue

Manpower: $145,000
Materials: $10,000

Key Technical Decisions

No key technical decisions were identified as being required for technology development of void fill methods.

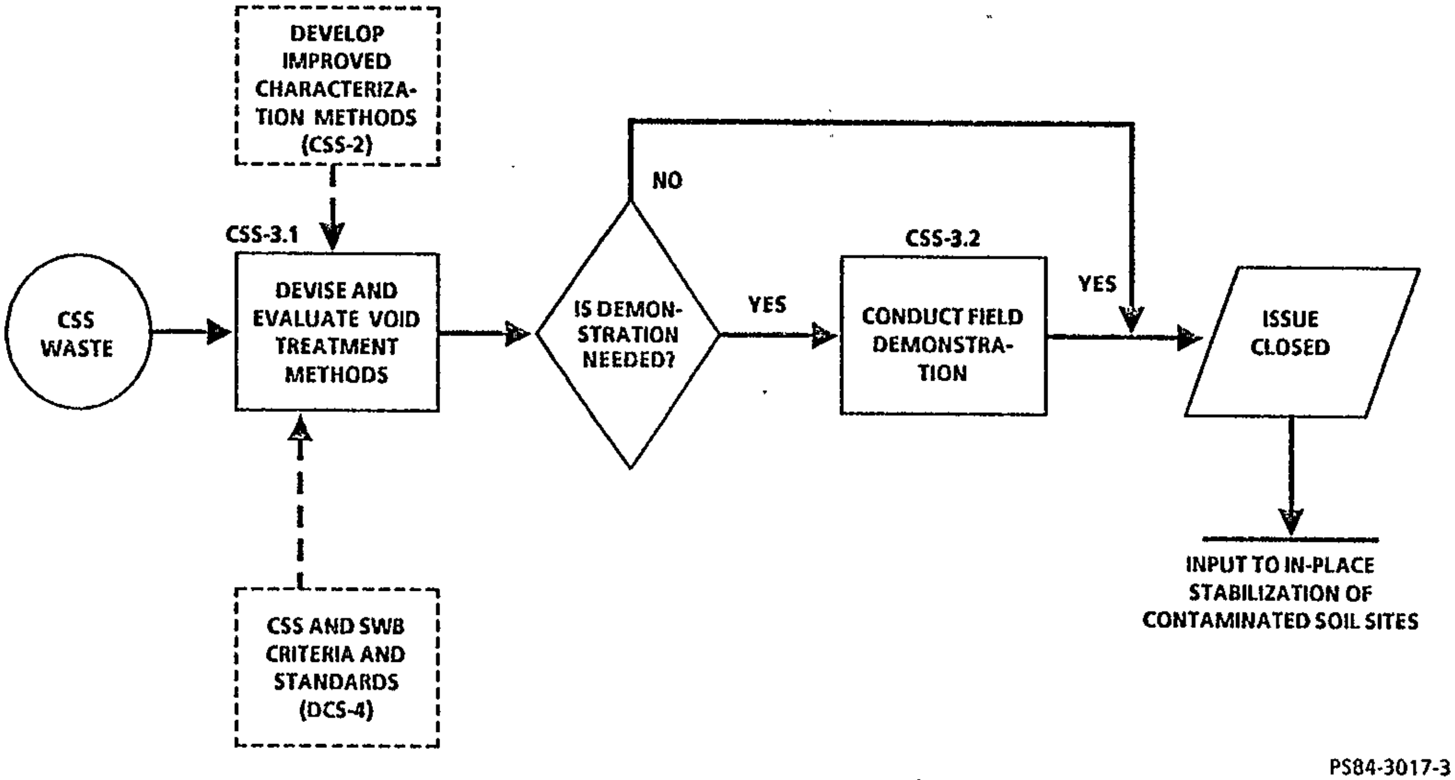

FIGURE VI-4. Flow Diagram CSS-3--Contaminated Soil Site Void Fill.

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Technical Issue CSS-4

TRU WASTE IMMOBILIZATION

Statement of Issue

The technical issue is: Is there a need to selectively immobilize (e.g., in situ vitrify) some TRU-contaminated areas in CSSs and, if so, what field-scale immobilization tests need to be performed and evaluated?

DOE Order 5820.2 states that TRU waste that cannot be certified for geologic disposal by practical techniques shall be disposed of by greater confinement. One important greater confinement disposal (GCD) method for buried TRU wastes includes subsidence control of the disposal site followed by construction of impermeable barriers. In-place stabilization and isolation of some contaminated soil sites containing high TRU concentrations and/or high hazardous chemical concentrations by emplacement of engineered barriers and markers may not be sufficient alone to comply with long-term disposal system performance requirements. For such sites, technology for in-place immobilization of the TRU elements and/or destruction of the hazardous chemical species prior to barrier emplacement needs to be developed and demonstrated.

Scope

The scope of this issue is limited to technology needed to complete development and demonstration of in situ vitrification (ISV) techniques proposed by Pacific Northwest Laboratory (PNL) investigators (Brouns et al., 1983). In situ vitrification is one of the technologies included within the purview of the GCD alternative for disposal of TRU wastes. (Greater confinement disposal of some TRU wastes provides a potentially attractive alternative to deep geologic emplacement of such wastes.) Other GCD technologies applicable to disposal of TRU waste at the Hanford Site include control of subsidence at disposal sites (Technical Issues CSS-3 and SWB-2) and emplacement of engineered barriers (Technical Issues SST-7, CSS-5, and SWB-4).

Status

In situ vitrification involves conversion of contaminated soils to an immobile glass and crystalline form by Joule heating. This ISV technology, an outgrowth of earlier PNL waste immobilization investigations, was conceived in 1980 and has developed rapidly. Over 23 engineering-scale and eight pilot-scale tests of the ISV process have been performed (Oma et al., 1983). In the seventh (June 1983) ISV pilot test, 25 kg of soil containing 600 nCi/g of TRU elements was successfully vitrified without release of radioactivity to the environment. The focus of the PNL ISV program has turned to design, fabrication, and testing of a large-scale system capable of vitrifying actual TRU disposal sites. Acceptance testing of this ISV system began in December 1984. A CSS suitable for an initial field-scale ISV demonstration was identified in FY 1984. The first radioactive test with the large-scale system is scheduled for January 1986.

Tasks to Close the Issue

The several tasks listed below must be completed to provide suitable technology for immobilization of TRU contaminated soil sites.

CSS-4.1 Identify TRU-CSS for ISV Test (Completed)

Identify a second retired TRU-CSS suitable for field-scale ISV demonstration. ($30,000)

CSS-4.2 Prepare documentation for ISV tests

Conduct engineering analyses, evaluations, and other studies of a proposed ISV demonstrations on actual TRU contaminated soil site. This task includes preparation of safety analysis reports and determination of environmental impacts. ($120,000)

CSS-4.3 Conduct cold vitrification test

Design, fabricate, and cold-test large-scale ISV equipment for vitrification of a TRU contaminated soil site. ($2,150,000)

CSS-4.4 Conduct field-scale ISV test on contaminated soil site

Conduct a large scale ISV demonstration on two TRU contaminated soil sites. ($3,280,000)

CSS-4.5 Post-monitor ISV tests

Analyze and evaluate results of ISV tests on contaminated soils; determine the applicability of ISV technology; make recommendations for further application of ISV technology. ($2,050,000)

CSS-4.6 Evaluate merit of ISV for selected CSSs

Perform engineering studies which compare the benefits, costs, and risks of ISV with proceeding only with site disposal by emplacement of engineered barriers and markers. It is anticipated ISV would be selectively applied only to high TRU concentration areas of some sites or selectively to mixed hazard TRU sites requiring remedial action. The studies will suggest the TRU concentration levels above which ISV would be beneficial and where it would not be applicable. ($1,150,000)

Flow Diagram

Figure VI-5 illustrates the logical order of performing the tasks required to close the TRU waste immobilization technical issue.

Costs to Close the Issue

Manpower: $8,780,000
Materials: $2,510,000

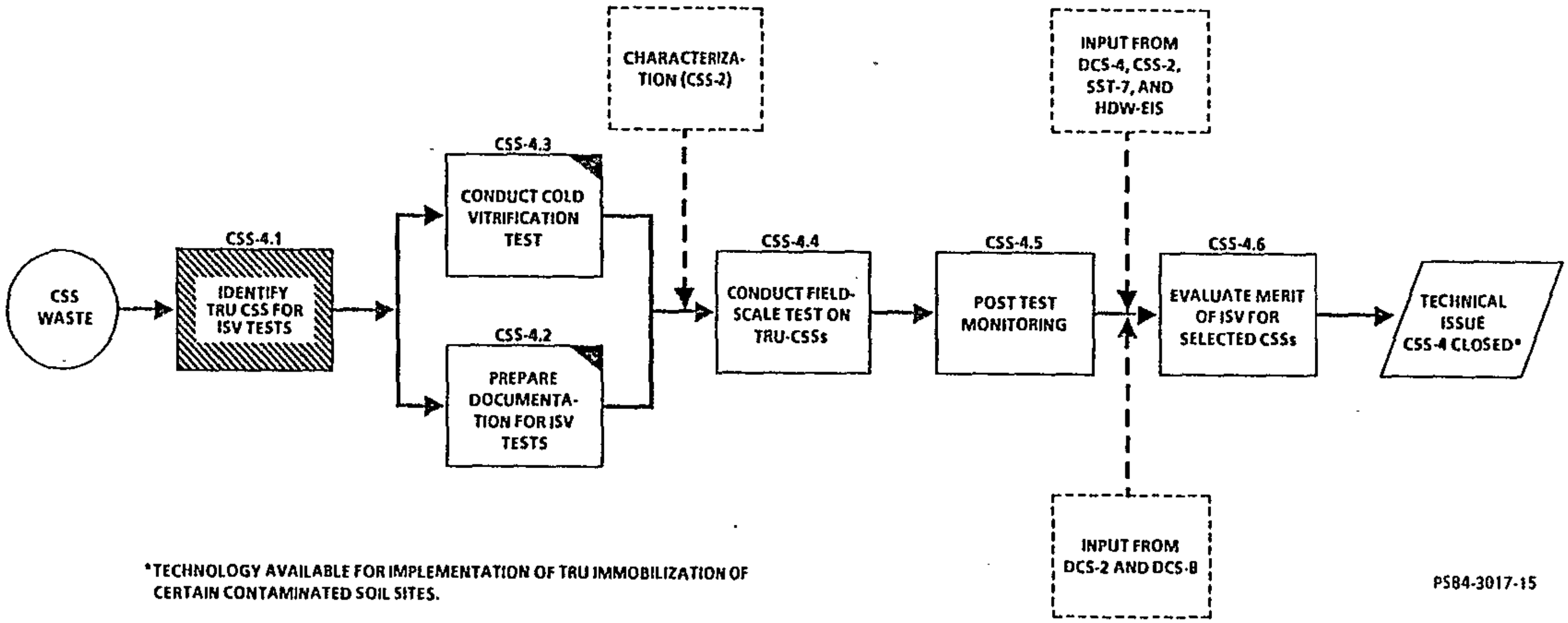
Key Technical Decisions

None.

Bibliography

Brouns, R, A., J. L. Buelt, and D. R. Brown (1983), U.S. Patent 4,376,598.

Oma, K. H., D. R. Brown, J. L. Buelt, V. F. Fitzpatrick, K. A. Hawley, G. B. Mellinger, B. A. Napier, D. J. Silviera, S. L. Stein, and C. L. Timmerman (1983), In Situ Vitrification of Transuranic Wastes: Systems Evaluation and Application Assessment, PNL-4800, Pacific Northwest Laboratory, Richland, Washington.



*TECHNOLOGY AVAILABLE FOR IMPLEMENTATION OF TRU IMMOBILIZATION OF CERTAIN CONTAMINATED SOIL SITES.

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FIGURE VI-5. Flow Diagram CSS-4--Transuranic Waste Immobilization.

Technical Issue CSS-5

PROTECTIVE BARRIERS

The Statement of Issue, Tasks to Close Issue, and Flow Diagram for Technical Issue SST-7 Protective Barriers all apply to this issue.

The following key technical decision must be made to resolve technical issue CSS-5:

CSS-5 (1): Is a field-scale demonstration of protective barriers technology for TRU contaminated soil sites necessary?

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Technical Issue CSS-6

MARKERS

The Statement of Issue, Tasks to Close Issue, and Flow Diagram for Technical Issue SST-8 Markers all apply to this issue.

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VII. SOLID WASTE BURIAL SITES

A. REFERENCE DISPOSAL PLAN

The reference plan for remedial action to enhance long-term stability of disposed solid waste burial (SWB) sites is shown in Figure VII-1. Table VII-1 lists significant dates associated with disposal of SWB waste.

B. SCHEDULE

Schedules for resolving the technical issues are shown in Figure VII-2.

C. COST SUMMARY

Table VII-2 summarizes the costs (escalated through FY 1987) associated with development of technology required to close the SWB technical issues.

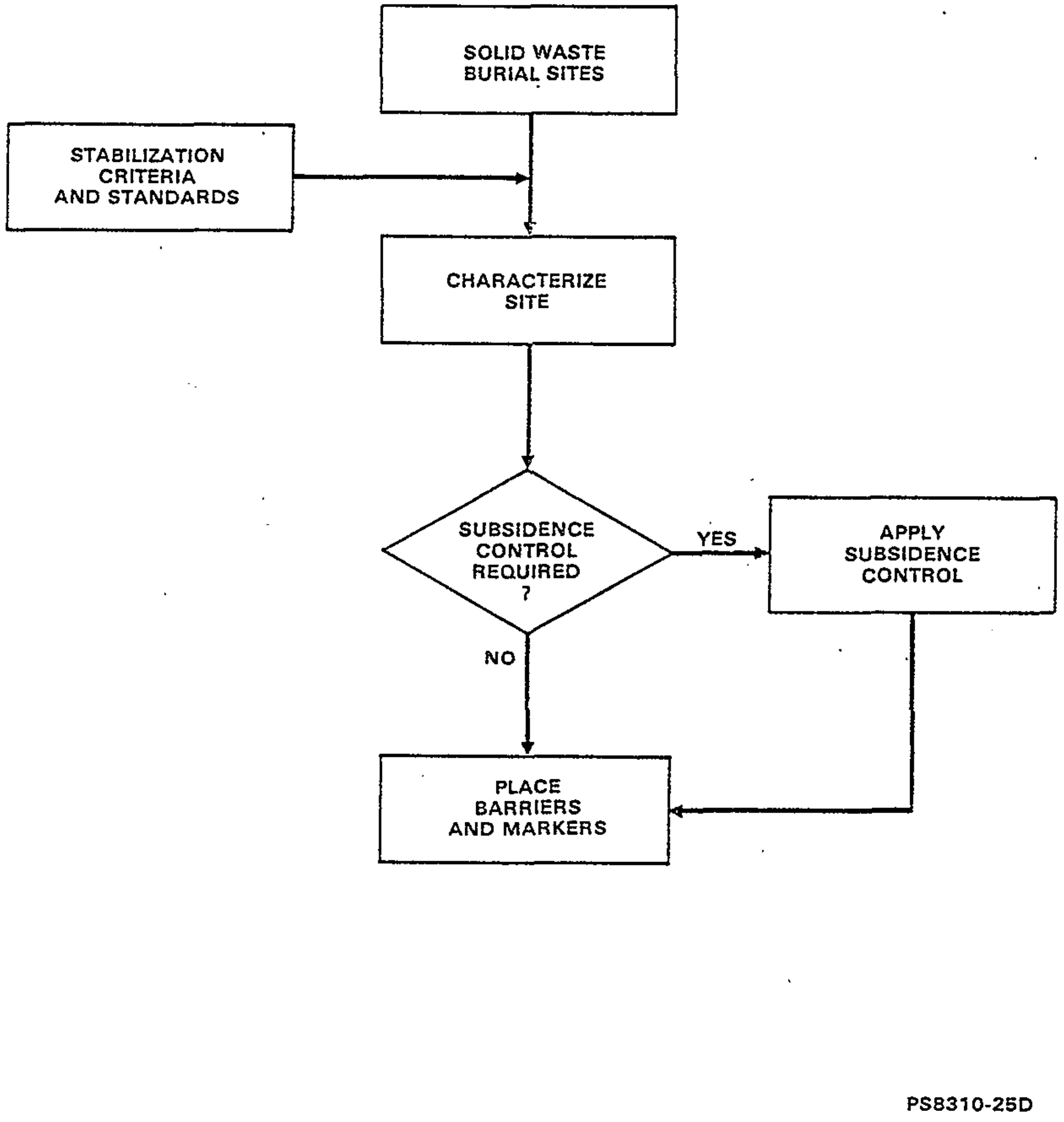

FIGURE VII-1. Reference Plan for In-Place Stabilization of Disposed Solid Waste Burial Sites.

9 1 1 2 5 1 0 1 5 1

TABLE VII-1. Significant Hanford Waste Management Dates--Solid Waste Burial Sites.

FY 1987	Complete solid waste burial site characterization methods development
FY 1992-2010	Conduct solid waste burial site in-place stabilization operations

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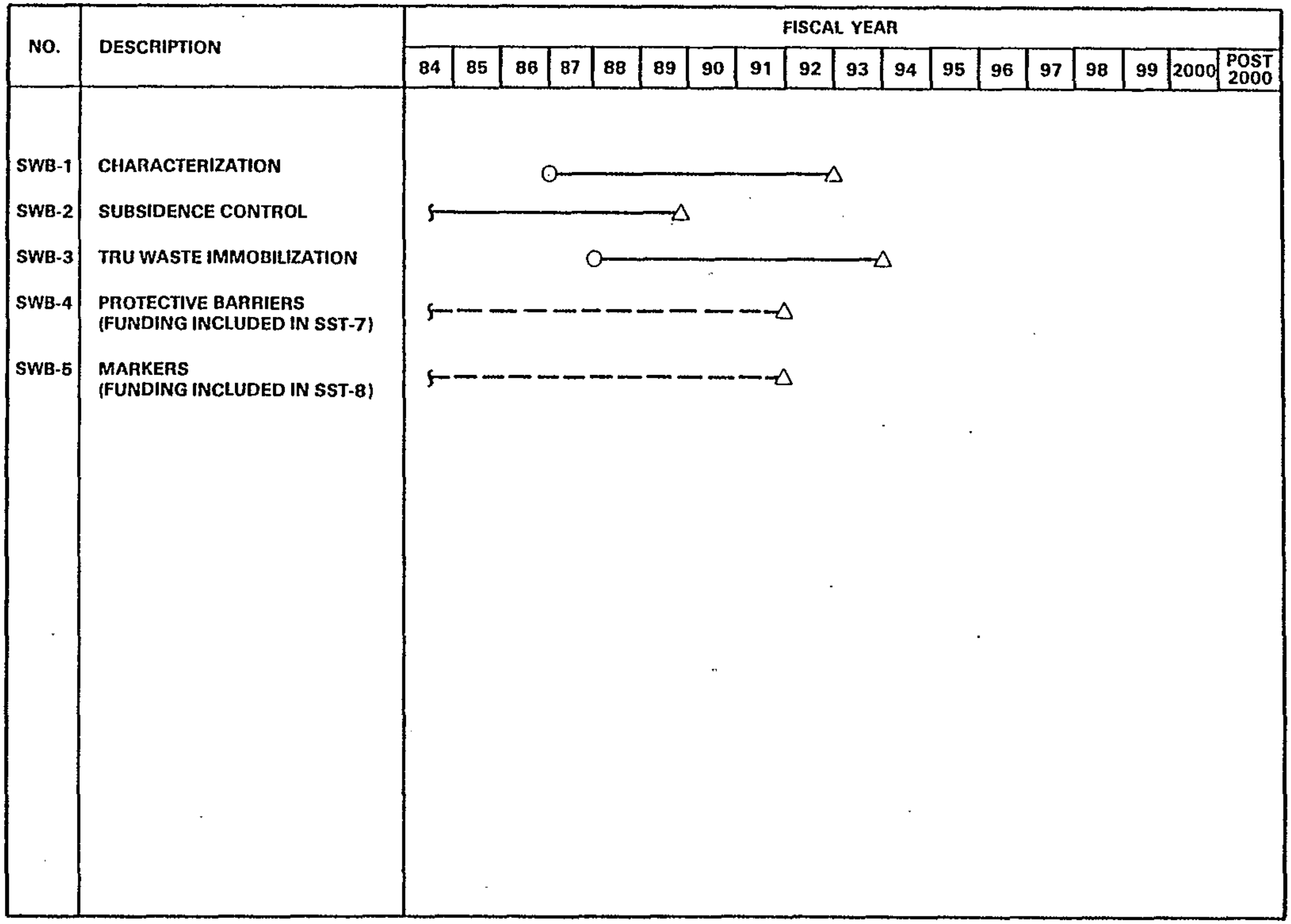

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FIGURE VII-2. Schedules for Resolving SWB Technical Issues.

TABLE VII-2. Estimated Technology Development Costs--Solid Waste Burial Sites.

Technical issue		Estimated costs ($1,000)			
Identification symbol	Title	Manpower	Material	Capital equipment	Total
SWB-1	Characterization	$3,550	$ 90	$350	$3,990
SWB-2	Subsidence Control	1,570	140	100	1,810
SWB-3	TRU Waste Immobilization	4,250	$1,520		5,770
SWB-4	Protective Barriers	a			a
SWB-5	Markers	b			b
	TOTAL (rounded)	$9,370	$1,750	$450	$11,600

[a]Costs included in those for Technical Issue SST-7.

[b]Costs included in those for Technical Issue SST-8.

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Technical Issue SWB-1

CHARACTERIZATION

Statement of Issue

The technical issue is: What degree of characterization of SWB sites is required to permit additional or remedial action to enhance the long-term stability of these wastes; what characterization techniques and instrumentation still remain to be developed, tested or upgraded?

Solid waste burial sites must be characterized prior to emplacement of engineered barriers to: (1) estimate the potential for undesirable site subsidence and to provide data for developing cost-effective stabilization; (2) support safety analyses and performance assessments; (3) comply with applicable laws and regulations; (4) address effluent and environmental control concerns; (5) confirm the existence of a TRU SWB site; and (6) validate sites and reclassify others.

Scope

Characterization of solid waste disposal sites requires collection of data relating to the following in order to plan for continued interim management and disposal (either onsite stabilization or retrieval of certain caissons):

- Waste burial site boundaries and location of subsurface structures
- Radionuclide (including ^{99}Tc) and chemical waste distribution and inventory
- Location of areas having significant potential for subsidence
- Distribution and inventory of hazardous wastes and mixed wastes (organic chemicals, solvents, complexants, toxic inorganics)
- Release mechanisms
- Local environmental characteristics and parameters.

A variety of characterization techniques can be utilized such as physical sampling, down-hole measurements (neutron well logs), remote sensing, and audits of historical records. The characterization of SWB sites will be difficult due to the extreme nonhomogeneity of the buried wastes. Therefore, careful consideration of the regulatory, performance assessment, and engineering data requirements is needed to insure that the appropriate data are collected in a cost effective manner.

Status

A reverse well, a French drain, a TRU crib, and a tank leak have all been previously characterized (Smith, 1980; Price et al., 1979; Van Luik and Smith, 1980; Routson et al., 1979) by means of physical sampling, waste disposal records, and down-hole radioactivity measurements. However, characterization has not been conducted on any SWB sites. One or more generically applicable burial sites should be characterized with emphasis on surface and near-surface radionuclide distributions and pathways for noncontainment as well as vadose zone movement of radionuclides.

Mobile Radionuclide Analysis Laboratories (MRAL I and MRAL II) are available for field use. These mobile units are equipped with microprocessor based multichannel analyzers and provide capabilities for real time, in-field radionuclide gamma spectral acquisition and data reduction. The MRAL I provides the capability to measure specific radionuclide concentrations by both sample-to-detector and soil-surface (in situ) modes.

A technical evaluation of subsurface burial ground mapping equipment identified two suitable systems: (1) a subsurface radar system and (2) a geophysical well logger.

In addition, statistically designed sampling methods and state-of-the-art analytical techniques are available for the characterization of soils for the presence of regulated or potentially regulated organic and inorganic constituents of hazardous and mixed hazardous wastes.

Tasks to Close the Issue

The following tasks close the issue of characterization of SWB sites:

SWB-1.1 Establish characterization requirements

Perform an engineering study to evaluate the minimum stabilization, safety analysis, regulatory, and environmental requirements needed for site characterization, as well as the needed accuracy of these requirements. ($50,000)

SWB-1.2 Evaluate present characterization technology

Evaluate characterization technology to determine technology needs and applicability to characterization of SWB sites. ($50,000)

SWB-1.3 Upgrade radionuclide and chemical characterization technology

Upgrade as required, current in-place instrumentation and methods for measuring fission product and TRU concentrations, and regulated organic and inorganic toxicants. ($205,000)

SWB-1.4 <u>Develop geophysical characterization instruments and techniques</u>

Identify and develop geophysical instruments and techniques needed for characterizing SWB sites. ($200,000)

SWB-1.5 <u>Characterize a selected SWB site</u>

Using established requirements, suitable sampling designs and strategies, and developed technology, characterize a generic SWB site. This detailed effort will provide the basis and establish relationships, if possible, for implementing routine procedures in future site characterizations. ($570,000)

SWB-1.6 <u>Identify release mechanisms</u>

Mechanisms controlling the release of hazardous chemicals and radionuclides from solid waste burial sites will be identified. Releases will be related to site inventories, waste form characteristics, local hydrogeology, and soil properties. Models that quantify the release from individual sites and groups of sites will be developed as input to performance assessments. This task will serve as input to DCS-1.4, -1.6, and -1.9. ($725,000)*

SWB-1.7 <u>Complete characterization of sites</u>

As necessary, complete characterization of SWB sites based on developed technology and results of detailed generic site characterization with a recognition of geochemical and transport modeling data needs. ($1,750,000)

<u>Flow Diagram</u>

Figure VII-3 illustrates the logical order of performing the tasks required to close the characterization issue for SWB sites.

<u>Costs to Close the Issue</u>

Manpower:	$3,550,000
Material:	$90,000
Capital Equipment:	$350,000

*Includes costs for contaminated soil sites.

Key Technical Decisions

No key technical decisions were identified as being required to characterize SWB sites.

Bibliography

Price, S. M., R. B. Kasper, M. K. Additon, R. M. Smith, and G. V. Last (1979), Distribution of Plutonium and Americium Beneath the 216-Z-1A Crib: A Status Report, RHO-ST-17, Rockwell Hanford Operations, Richland, Washington.

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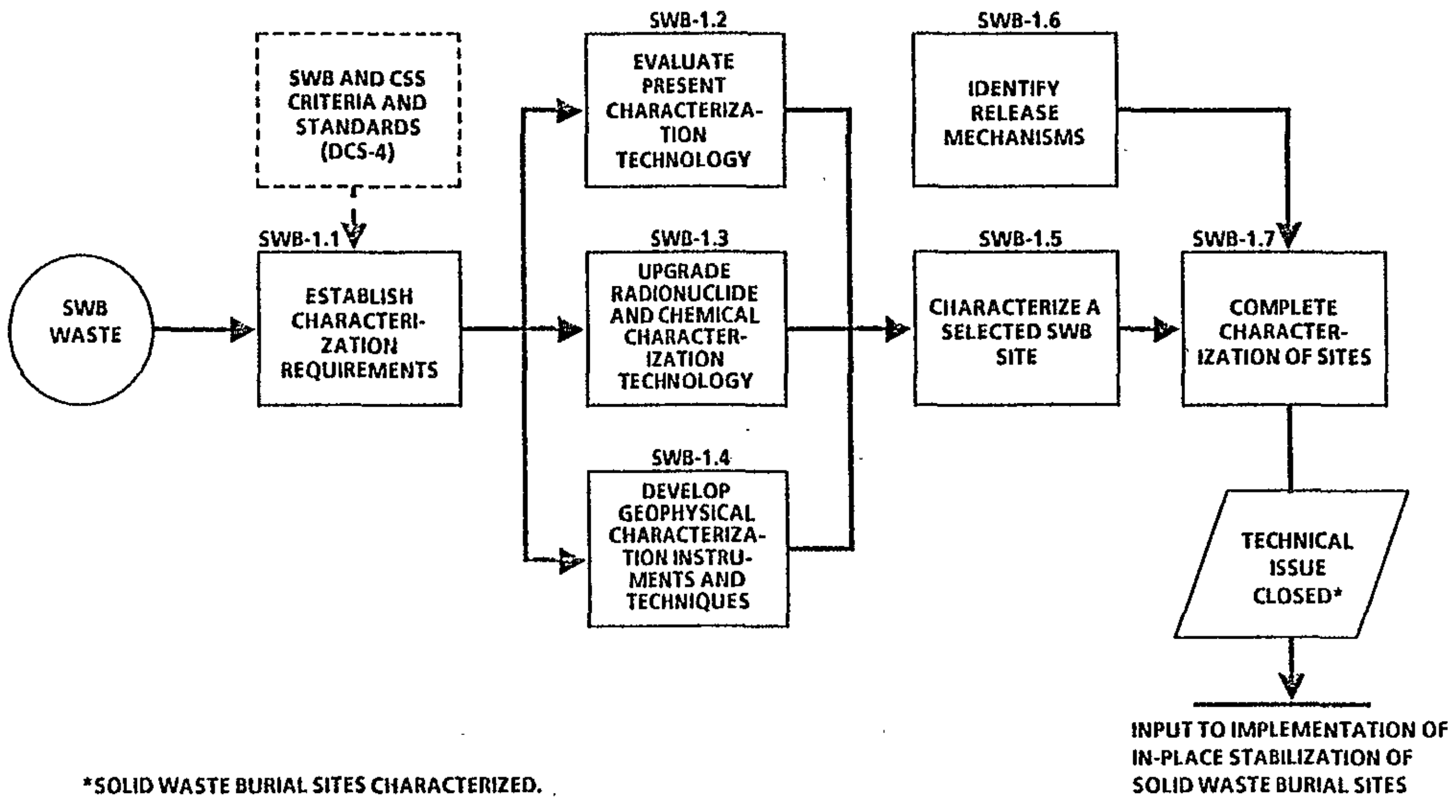

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FIGURE VII-3. Flow Diagram SWB-1--Characterization.

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Technical Issue SWB-2

SUBSIDENCE CONTROL

Statement of Issue

The technical issue is: What technical work needs to be done to define procedures for preventing and controlling subsidence of soils in SWB sites?

Subsidence in SWB sites can result in dispersal of radionuclides, uptake of radionuclides by flora and fauna, increased occupational exposure, and unacceptably high maintenance costs. Efficient and cost-effective techniques for preventing and controlling soil subsidence in SWB sites must be developed as part of the overall technology base for in-place stabilization of such sites.

Scope

The scope of the activities required to resolve this issue include the development and demonstration of geotechnical techniques to preclude or significantly reduce subsidence of retired solid waste burial sites and the development, testing, and demonstration of methodologies to treat new waste materials currently destined for disposal in low-level waste (LLW) trenches.

Caissons in solid waste burial sites range from large pipes buried vertically in the ground to large concrete structures equipped with disposal chutes and High Efficiency Particulate Air (HEPA) filtration systems. Caissons are typically located within the confines of existing burial grounds; the 222-S Vaults in the 200 West Area are an exception. These latter caissons are located near the 222-S Building and were used for storage of various packages of laboratory wastes. The scope of technology needed to close this issue includes selection and evaluation of methods to fill voids in caissons and field-scale demonstration of recommended fill procedures.

Status

Various alternative techniques to control subsidence and stabilize low-level and TRU solid waste burial sites have been proposed (Phillips and Carlson, 1981). A Geotechnical Test Facility (GTF) for use in testing and demonstrating methods for controlling soil subsidence has been constructed. The proposed subsidence control method using pile-driving has been tested at the GTF and also on an actual buried waste package in the 218-W-2A burial ground.

Past studies which addressed in-place disposal of caissons, including demonstration of such disposal, have been completed. As part of these studies, methods for filling voids in caissons were devised and evaluated; the recommended method involved loose filling of the caisson with soil and emplacement of an intrusion cover over the caisson.

Tasks to Close the Issue

The following tasks close the issue of subsidence control of SWB sites.

SWB-2.1 Evaluate geotechnical properties

Conduct laboratory-scale studies to evaluate geotechnical properties of soil and waste materials relevant to subsidence occurrence and control. ($185,000)

SWB-2.2 Evaluate barrier subsidence effects

Perform a study to identify engineered barrier design features to minimize the adverse effects of subsidence on barrier performance. ($30,000)

SWB-2.3 Test subsidence barriers

Test various candidate subsidence barriers and evaluate results. ($210,000)

SWB-2.4 Develop and demonstrate methods for void fill of new waste materials

Develop and demonstrate methods for void fill of new waste materials currently destined for disposal in LLW trenches. Assessment of methods to provide acceptable greater confinement for specific caissons found to exceed isotopic inventory limits will be evaluated as part of this task. ($200,000)

SWB-2.5 Devise backfill techniques

Devise techniques to backfill cribs, caissons, industrial waste packages, etc. ($300,000)

SWB-2.6 Demonstration in actual SWB sites

Conduct field tests of most promising subsidence control procedures in actual radioactive SWB sites. ($645,000)

Flow Diagram

Figure VII-4 illustrates the logical order of performing the tasks required to close the subsidence control technical issue for SWB sites.

Costs to Close the Issue

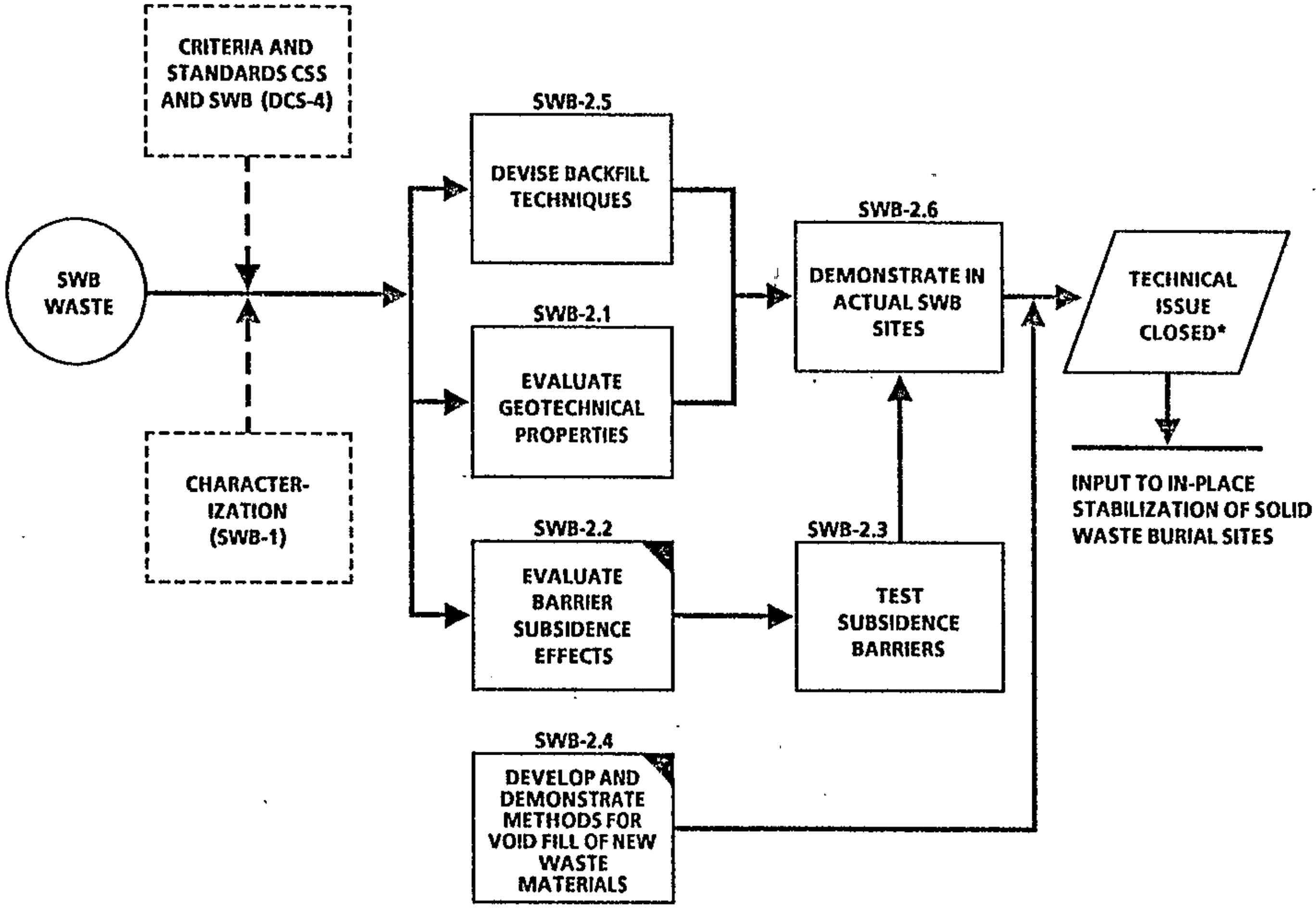
Manpower:	$1,570,000
Materials:	$140,000
Capital Equipment:	$100,000

Key Technical Decisions

No key technical decisions were identified for the subsidence control technical issue.

Bibliography

Phillips, S. J. and Carlson, R. A. (1981), Alternatives to Control Subsidence at Low-Level Radioactive Waste Burial Sites, RHO-LD-172, Rockwell Hanford Operations, Richland, Washington.



*TECHNOLOGY FOR SUBSIDENCE CONTROL AVAILABLE FOR IMPLEMENTATION.

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FIGURE VII-4. Flow Diagram SWB-2--Subsidence Control.

Technical Issue SWB-3

TRU WASTE IMMOBILIZATION

Statement of Issue

The technical issue is: Is there a need to selectively immobilize (e.g., in situ vitrify) some TRU-contaminated areas in SWB sites and, if so, what field-scale immobilization tests need to be performed and evaluated?

DOE Order 5820.2 states that TRU waste that cannot be certified for geologic disposal by practical techniques shall be disposed of by greater confinement. One important greater confinement disposal (GCD) method for buried TRU wastes includes subsidence control of the disposal site followed by construction of impermeable barriers. Onsite stabilization and isolation of some solid waste burial sites containing high TRU concentrations and/or high hazardous chemical concentrations by emplacement of protective barriers and markers may not be sufficient alone to comply with long-term disposal system performance requirements. For such sites, technology for in-place immobilization of the TRU elements and/or destruction of the hazardous chemical species prior to barrier emplacement needs to be developed and demonstrated.

Scope

The scope of this issue is limited to technology needed to complete development and demonstration of ISV techniques proposed by PNL investigators (Brouns et al., 1983).

Status

In situ vitrification involves conversion of contaminated soils to an immobile glass and crystalline form by Joule heating. This ISV technology, an outgrowth of earlier PNL waste immobilization investigations, was conceived in 1980 and has developed rapidly. Over 23 engineering-scale and eight pilot-scale tests of the ISV process have been performed (Oma et al., 1983). In the seventh (June 1983) ISV pilot test, 25 kg of soil containing 600 nCi/g of TRU elements were successfully vitrified without release of radioactivity to the environment. The focus of the PNL ISV program has turned to design, fabrication, and testing of a large-scale system capable of vitrifying actual TRU disposal sites. Acceptance testing of this ISV system began in December 1985.

Tasks to Close the Issue

The several tasks listed below must be completed to provide suitable technology for immobilization of TRU solid waste burial sites.

SWB-3.1 Determine incentive for ISV

Perform an engineering study that compares the benefits, costs, and risks of ISV with proceeding only with site disposal by emplacement of protective barriers and markers. It is anticipated ISV would be selectively applied only to high TRU concentration sites. The study will suggest the TRU concentration levels above which ISV would be applied and where it would not be applicable. ($200,000)

SWB-3.2 Identify a TRU SWB site for ISV test

Identify a retired TRU SWB site suitable for field-scale ISV demonstrations. ($50,000)

SWB-3.3 Prepare documentation for ISV tests

Conduct engineering analyses, evaluations, and other studies of a proposed ISV demonstration on an actual TRU-SWB site. ($150,000)

SWB-3.4 Conduct cold vitrification tests

Design, fabricate, and cold-test large-scale ISV equipment for vitrification of a TRU-SWB site. ($1,000,000)

SWB-3.5 Conduct ISV field-scale test on TRU SWB site

Conduct a large scale ISV demonstration on a TRU-SWB site. ($1,900,000)

SWB-3.6 Post-monitor ISV tests

Analyze and evaluate results of ISV tests on an SWB site; determine the applicability of ISV technology to other Hanford TRU-SWB sites and make recommendations. ($800,000)

SWB-3.7 Evaluate merit of ISV for selected SWB sites

Perform an engineering study which defines the benefits, costs, and risks of selectively vitrifying SWB sites with high TRU zones. The study will suggest the TRU concentration levels above which ISV would be beneficial and where it would not be applicable. ($150,000)

Flow Diagram

Figure VII-5 illustrates the logical order of performing the tasks required to close the TRU waste immobilization technical issue.

Costs to Close the Issue

Manpower: $4,250,000
Materials: $1,520,000

Key Technical Decisions

- SWB-3 (1): Is in situ vitrification necessary for immobilization of TRU contaminated solid waste burial sites?

A "no" answer would eliminate the need to perform the following tasks:

- Identify a TRU SWB site for ISV test. ($50,000)
- Prepare documentation for ISV tests. ($150,000)
- Conduct cold vitrification tests. ($1,000,000)
- Conduct ISV field-scale test on TRU SWB site. ($1,900,000)
- Postmonitor ISV tests. ($800,000)
- Evaluate merit of ISV for selected SWB sites. ($150,000)

The total cost savings would be $4,050,000.

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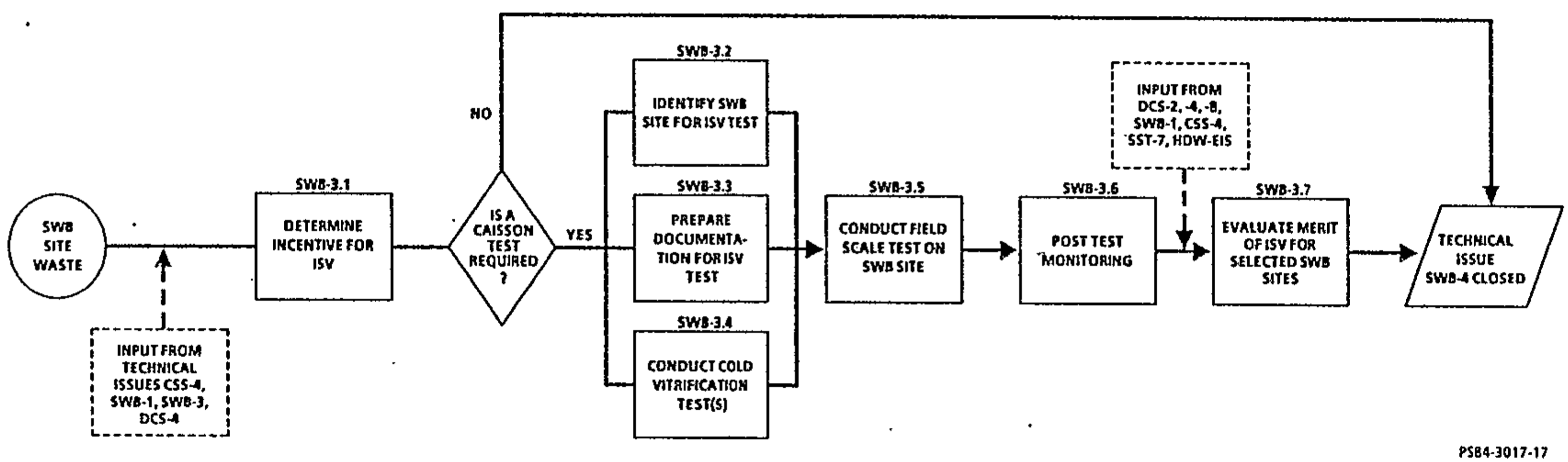

FIGURE VII-5. Flow Diagram SWB-3--Transuranic Waste Immobilization.

Technical Issue SWB-4

PROTECTIVE BARRIERS

The Statement of Issue, Tasks to Close Issue, and Flow Diagram for Technical Issue SST-7 Protective Barriers all apply to this issue.

The following key technical decision must be made to resolve technical issue SWB-4:

SWB-4 (1): Is a field-scale demonstration of protective barriers technology for TRU-SWB sites necessary?

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Technical Issue SWB-5

MARKERS

The Statement of Issue, Tasks to Close Issue, and Flow Diagram for Technical Issue SST-8 Markers all apply to this issue.

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VIII. DOUBLE-SHELL TANK WASTES

A. REFERENCE DISPOSAL PLAN

The reference plan for disposal of double-shell tank (DST) wastes is shown in Figure VIII-1. Table VIII-1 lists significant dates associated with disposal of DST waste.

B. SCHEDULE

Schedules for resolving the technical issues are shown in Figure VIII-2.

C. COST SUMMARY

Table VIII-2 summarizes the costs associated with development of technology required to close the DST technical issues.

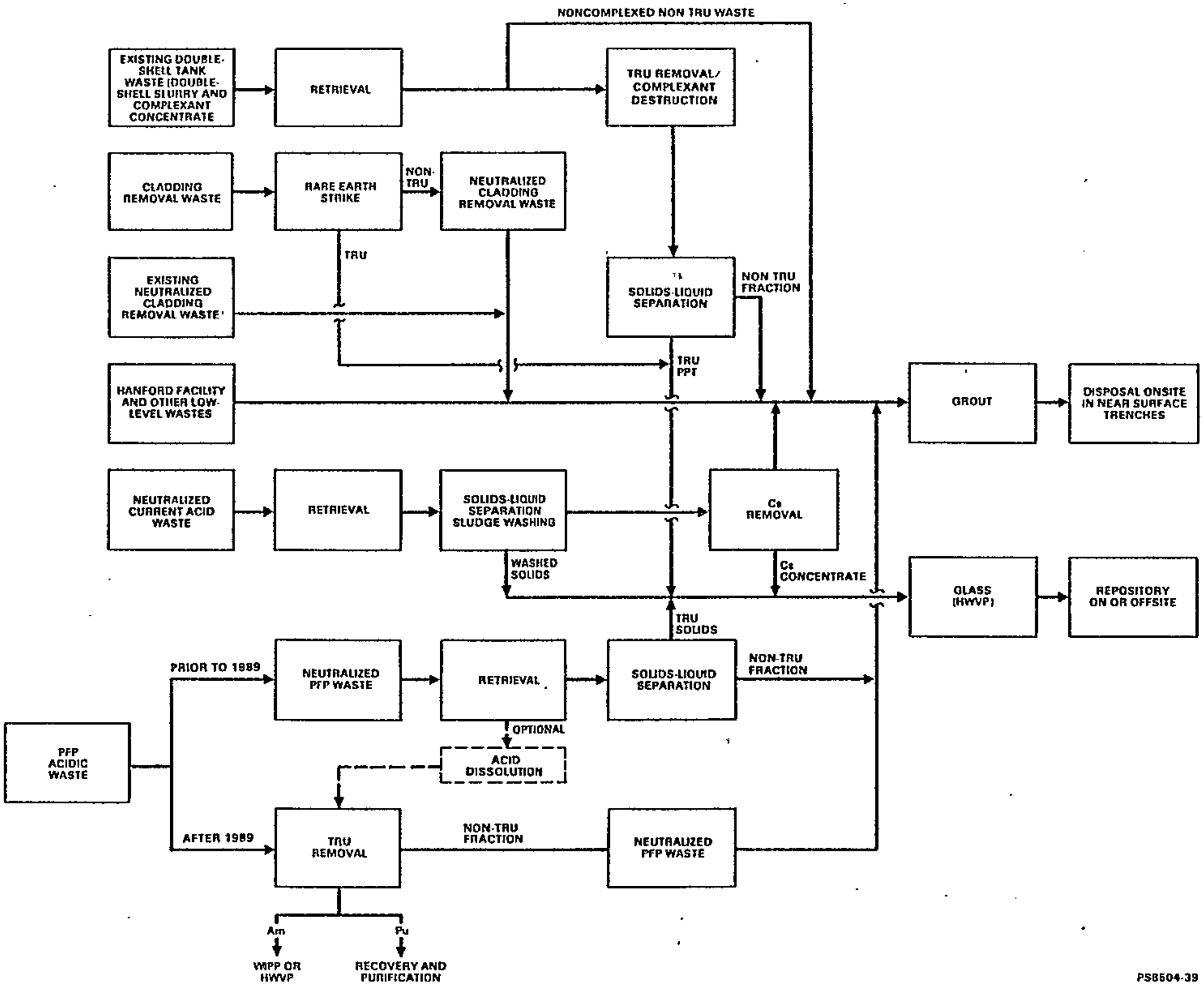

FIGURE VIII-1. Reference Plan for Disposal of Double-Shell Tank Wastes.

TABLE VIII-1. Significant Hanford Waste Management Dates - Double-Shell Tank Wastes.

FY 1988	Complete transportable grout facility design and construction--begin operations
FY 1989	Implement TRU removal from PFP aqueous waste
FY 1993	Complete HWVP design and construction
FY 1994	Start HWVP operations
Post-2000	Complete grout operations
Post-2000	Complete HWVP operations

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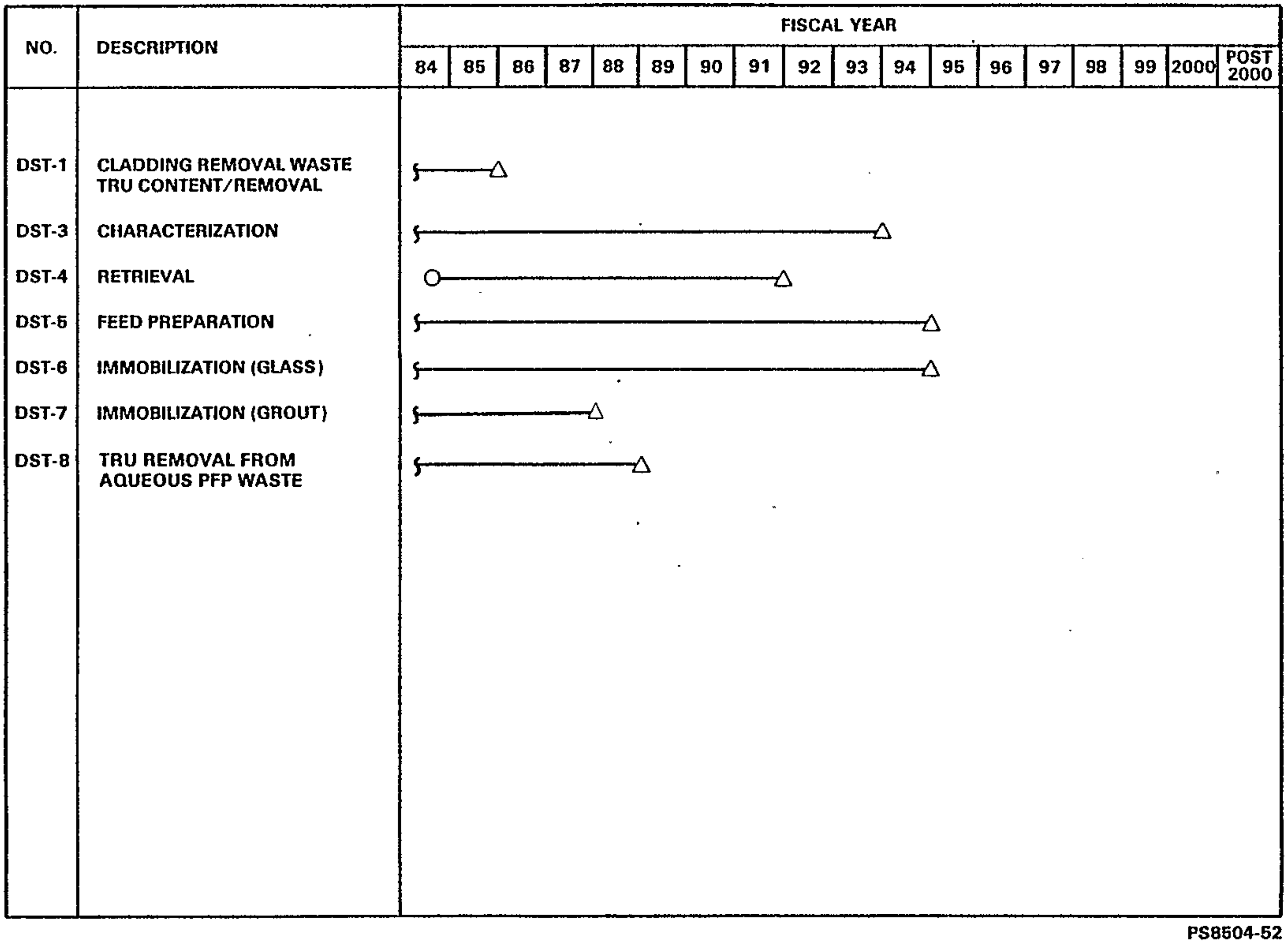

FIGURE VIII-2. Schedules for Resolving Double-Shell Tank Technical Issues.

TABLE VIII-2. Estimated Technology Development Costs - Double-Shell Tank Wastes.

Technical issue		Estimated costs ($1,000)			
Identification symbol	Title	Manpower	Material	Capital equipment	Total
DST-1	CRW TRU Content/ Removal	$ 177			$ 177
DST-2	Interim Management	a	a	a	a
DST-3	Characterization	8,200	$ 400	$ 470	9,070
DST-4	Retrieval	3,080	90	705	3,880
DST-5	Feed Preparation	7,420	1,100	1,240	9,760
DST-6	Immobilization (Glass)	96,500	14,200		110,700
DST-7	Immobilization (Grout)	14,700	350	120	15,200
DST-8	TRU Removal from Aqueous PFP Waste	1,680		400	2,080
	TOTAL (rounded)	$132,000	$16,200	$2,940	$151,000

[a]Costs for Interim Management shown in Appendix B.

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Technical Issue DST-1

CLADDING REMOVAL WASTE TRU CONTENT/REMOVAL

Statement of Issue

The technical issue is: Is Cladding Removal Waste (CRW) and hence Neutralized Cladding Removal Waste (NCRW) a TRU-type waste and, if so, what technology needs to be developed, tested, and implemented to make CRW a non-TRU waste?

Future Hanford PUREX process operations will generate CRW (and, hence, NCRW) which may be TRU-type waste (i.e., $\geq$100 nCi of alpha emitting TRU elements per gram of waste). Because of the large amounts of waste involved, economic considerations strongly favor near-surface disposal of NCRW (in grout) over vitrification and geologic disposal. There is a pressing need for accurate knowledge of the TRU content of CRW to guide development of technology which could be used, if necessary, to remove TRU elements prior to neutralization and storage of NCRW in double-shell tanks (DST).

Scope

The ammonium fluoride-ammonium nitrate solution used to dissolve zirconium cladding from N-Reactor fuel also attacks the uranium metal core to some extent forming UF_4 and both soluble and insoluble TRU element species. If sufficient TRU elements carry through the centrifuge in either soluble or fine solids form, the TRU content of some of the future CRW may be greater than 100 nCi/g. The scope of the needed technology for CRW TRU content determination and removal prior to neutralization includes:

- Analytical determination of the TRU content of plant- and laboratory-produced CRW solutions and solids.

- Laboratory studies with simulated and actual CRW solutions to develop and demonstrate technically feasible precipitation or other appropriate processes for reduction of TRU levels to below 100 nCi/g.

- Engineering studies to determine operability and economic feasibility of plant-scale processes for removal of TRU elements from CRW.

If removal of TRU elements from CRW is necessary, the TRU-bearing fraction would be processed in the HWVP and the non-TRU fraction would be immobilized in grout.

Status

Little analytical data exist from previous PUREX Zirflex process operations to judge the expected TRU element content of CRW and NCRW wastes. Recent results based on PUREX NCRW from 6% ^{240}Pu fuel place the TRU content of CRW settled solids in the range of 32 to 335 nCi/g, corresponding to approximately 12 to 122 nCi/g in grout. These data indicate grouted NCRW will be a TRU waste (i.e., contain >100 nCi/g TRU), especially when higher plutonium content 12% ^{240}Pu fuel is considered.

Laboratory studies with both simulated CRW and CRW produced from irradiated fuel have shown that the ^{241}Am has a low solubility in CRW and does not contribute appreciably to the initial TRU content of the waste. These studies also show that the relatively soluble Pu(IV) in CRW can be held in the less soluble Pu(III) state by the presence of uranium or Zircaloy metal.

The laboratory tests have also confirmed the feasibility of the rare earth co-precipitation process for removal of soluble Pu. A small amount of rare earth nitrate added to CRW removes greater than 90% of the Pu and produces less than 1.0 vol% centrifuged solids.

Preliminary flowsheets for CRW-TRU removal treatment (rare earth fluoride precipitation) in PUREX and B Plant were completed, and an implementation plan was prepared for the actions required to install the process at B Plant. A technology study which compared the technical and economic aspects of the rare earth process at PUREX and B Plant was completed. The study recommended implementation at PUREX and further consideration of the passive Zircaloy reductant concept, while maintaining a B Plant option until PUREX plant tests are complete. A PUREX plant test was performed which demonstrated that the rare earth process was feasible. A final decision was recently made to implement TRU removal at PUREX. Flowsheet development and facility upgrades are presently in progress.

Tasks to Close the Issue

The following tasks close the issue of TRU content/removal from CRW.

DST-1.1 Obtain plant and in-tank samples (Complete)

Obtain plant samples from PUREX of both unneutralized and neutralized CRW. Obtain samples of NCRW settled solids from the 103-AW tank. (Completed in FY 1985)

DST-1.2 Develop analytical procedures (Complete)

Develop satisfactory analytical procedures to determine soluble and insoluble concentrations of americium and plutonium in actual CRW and NCRW. (Completed in FY 1984)

DST-1.3 Generate laboratory-scale CRW samples (Completed)

Design and conduct bench-scale hot cell decladding tests with representative indicated N-Reactor fuel. (Completed in FY 1984)

DST-1.4 Determine TRU content of actual CRW and NCRW (Completed)

Determine the TRU content, soluble and insoluble, in the samples obtained from PUREX and Tank 103-AW. Assess the potential carryover of TRU solids through PUREX centrifuges by comparing TRU analyses of neutralized and unneutralized CRW solutions. (Completed in FY 1985)

DST-1.5 Complete laboratory-scale development of TRU removal processes (Completed)

Design and conduct bench-scale experiments using both Pu-spiked CRW solutions and solutions prepared from irradiated N-Reactor fuel to further test and evaluate the rare earth co-precipitation and other [e.g., Pu(IV)/Pu(III)] reduction processes for removal of TRU elements from CRW solution. (Completed in FY 1985)

DST-1.6 Perform engineering study of rare earth fluoride co-precipitation process

Perform studies to determine the technical and economic feasibility of rare earth fluoride co-precipitation of TRU elements from CRW including earliest plant-scale operability. Provide flowsheets and determine the scope of facility modifications for installation of the rare earth fluoride co-precipitation process. ($177,000)

DST-1.7 Perform plant-scale tests of TRU removal processes (Completed)

Conduct plant-scale tests in PUREX of the rare earth fluoride co-precipitation process and other procedures for maintaining the TRU concentration of grouted NCRW solids at levels below 100 nCi/g. (Completed in FY 1985)

Flow Diagram

Figure VIII-3 illustrates the logical order of performing the tasks required to close the CRW-TRU content/removal issue.

Costs to Close the Issue

Manpower: $177,000

Key Technical Decisions

- DST-1 (1): Is NCRW a TRU waste?

- DST-1 (2): Will plant-scale TRU removal be performed?

The following answer combinations for the key technical decisions would result in elimination of noted tasks.

A. DST-1 (1) = No

- Complete engineering study of rare earth fluoride precipitation process. ($177,000)

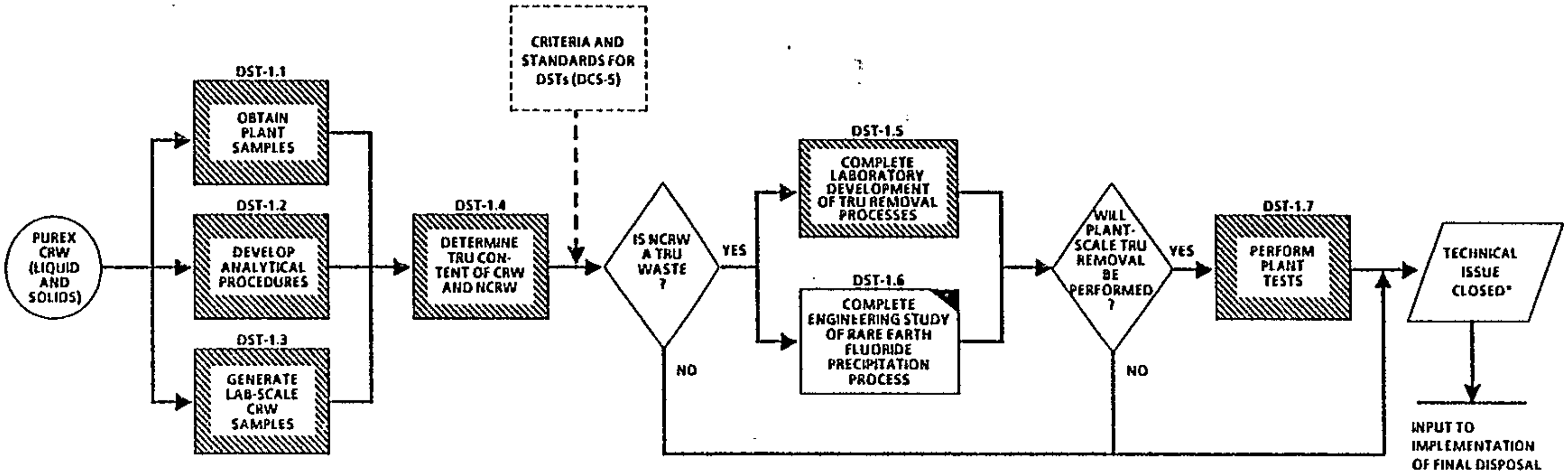
- Perform plant-scale tests of TRU removal process. (Covered by operational expenses)

B. DST-1 (1) = Yes; DST-1 (2) - No

- Perform plant-scale tests of TRU removal process. (Covered by operational expenses)

C. DST-1 (1) = Yes; DST-1 (2) - Yes

- None of the tasks would be eliminated; i.e., no cost savings.



*NCRW CAN BE SATISFACTORILY DISPOSED OF IN NEAR-SURFACE FACILITY.

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FIGURE VIII-3. Flow Diagram DST-1--Cladding Removal Waste Transuranic Content/Removal.

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Technical Issue DST-2

INTERIM MANAGEMENT

For reasons stated on page I-4, this Technical Issue is now addressed in appendix B.

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Technical Issue DST-3

CHARACTERIZATION

Statement of Issue

The technical issue is: What are the amounts, compositions, and physical and chemical properties of all the double-shell tank wastes?

Reliable knowledge of the inventory and properties of chemicals and radionuclides in DST wastes is necessary for efficient management of tank space and to determine proper pretreatment and/or disposal procedures. Adequate characterization of such wastes is a highly technical operation which must be carefully planned and accomplished in a cost-effective manner. This particular issue relates to organization and performance of the needed sampling, analytical procedures, and analyses.

Scope

Waste characterization is required to determine pretreatment requirements for wastes prior to immobilization and to determine the final disposal waste form option for the waste (i.e., grout or glass). Characterization is also required to efficiently manage existing space for the storage of future PUREX and Hanford Facility wastes consistent with the safe and cost-effective permanent disposal of all waste. The following waste characteristics need to be identified:

- The TRU and total organic carbon (TOC) content of double-shell slurry (DSS) and CC. If both TRU and TOC contents are sufficiently low, destruction of the organic complexants prior to immobilization of DSS in grout may not be necessary. Other analyses (e.g., Na^+, Cl^-, F^-) are required to permit development of grout formulations.

- Composition of supernatant from NCAW and determination of actinide content.

- Composition of sludge from NCAW. The requirements for washing the sludge to remove sodium salts, organic carbon and sulfate must be evaluated. The concentration of zirconium in the sludge must be determined. The characterization results will help define the optimum glass formulations for effective immobilization.

- Composition of NCRW and determination of actinide content. (Composition of CRW prior to neutralization is addressed in DST-1.)

- Composition of neutralized PFP waste and determination of actinide content.

- Identification of release mechanisms for grouted DST wastes is addressed in Technical Issue DST-7.

Samples for characterization of the waste will be obtained from process waste streams prior to storage in tanks and from waste stored in tanks. Waste compositions will also be predicted by computer simulation (e.g., TRAC model) using historical reactor and chemical processing data. Data from actual process and tank samples will be used to validate the TRAC computer model.

The distribution and inventory of hazardous wastes will be characterized as part of the scope of this issue.

Characterization of double-shell tank wastes will be necessary throughout the entire storage time required to dispose of such wastes.

Status

Computer codes are being developed for prediction of waste tank inventories. Tank inventories have been estimated through 1980.

No proven technology exists for sampling DSS in double-shell tanks, although existing core sampling techniques used for single-shell tanks are applicable.

Improved analytical methods for determining Am, Pu, EDTA, HEDTA, and other complexant organic concentrations in wastes were recently developed. Development of the Delayed Neutron Activation Analysis System (DNAAS) for nondestructive measurement of ^{239}Pu in complex sample matrices is well along.

Complexed concentrate waste from three DSTs has been sampled and complete characterization of the waste is nearly complete. Analyses to date indicate that this waste is TRU.

Tasks to Close the Issue

The following tasks close the issue of characterization of DST wastes:

DST-3.1 Develop DST sampling method

Develop a sampling method for DST wastes. Existing core sampling techniques will be investigated and used, if applicable. If not, new equipment will be developed. Specific statistical designs will be used in conjunction with the core sampling techniques. ($800,000)

DST-3.2 Develop analytical methods for DST waste

Complete development of qualified methods and procedures as required for analysis of chemical components of DST wastes. Complete development of an analytical method for organic degradation products from complexant destruction. Provide transfer of developed technology. ($600,000)

In particular, methods for sampling the evaporator should be addressed.

DST-3.3 Develop sampling methods for process streams sent to DSTs

Update waste stream sampling methods to obtain characterization data for waste destined for DST storage. In particular, methods for sampling the evaporator should be addressed. ($150,000)

DST-3.4 Complete development of the DNAAS

Develop the DNAAS for nondestructive measurement of plutonium in complex sample matrices. ($150,000)

DST-3.5 Sample and analyze selected DST waste

Sample and analyze process waste streams and waste in selected tanks as needed. The TRU analyses of CAW, NCAW supernatant, NCRW, neutralized PFP, and DSS are needed as soon as possible. ($1,500,000)

DST-3.6 Characterize all DST wastes

Complete characterization of all DST waste types (NCAW, NCRW, CC, DSS, and PFP) using (a) computer model estimations, (b) analysis of process waste streams, (c) sampling and analysis of waste in tanks. Develop data base for characterization analyses. ($5,000,000)

Flow Diagram

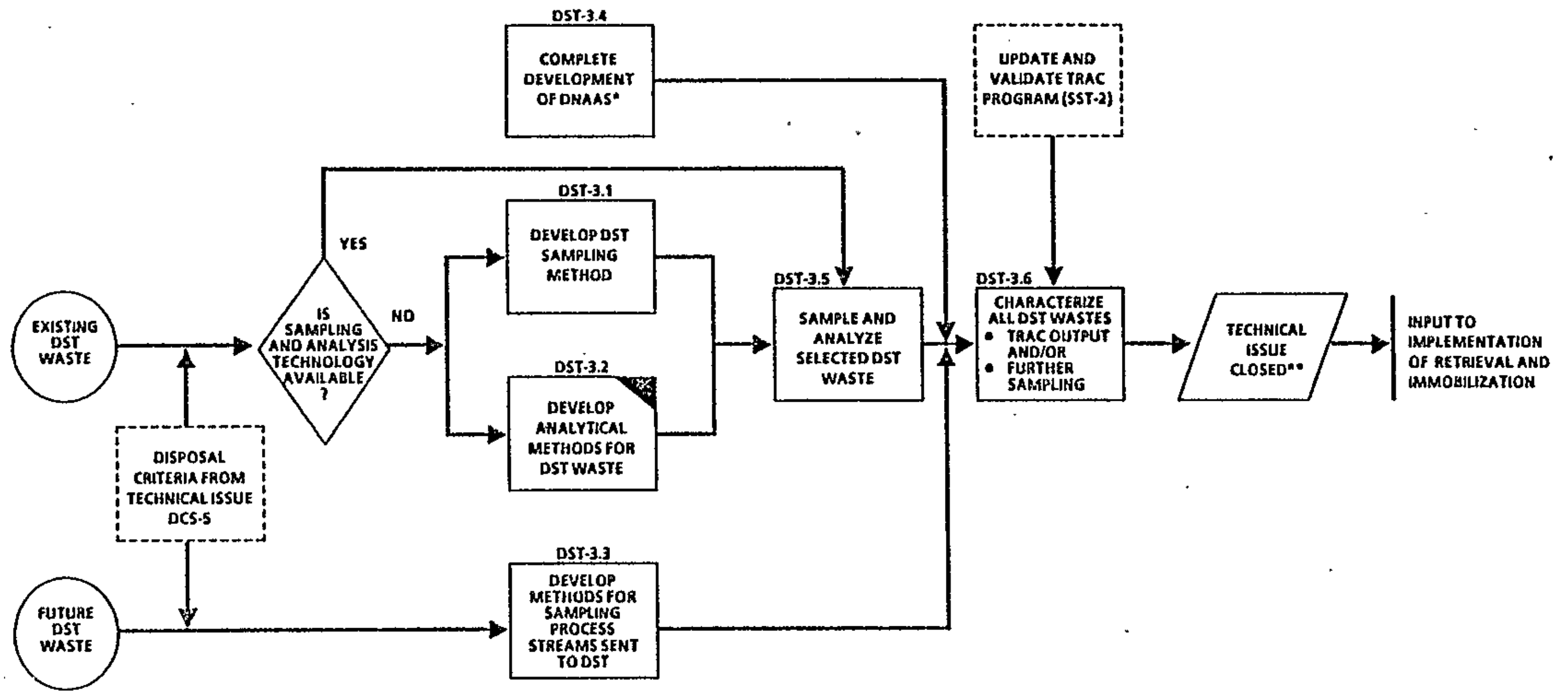
Figure VIII-4 illustrates the logical order for performing tasks to close the issue of characterization of DST wastes.

Costs to Close the Issue

Manpower:	$8,200,000
Materials:	$400,000
Capital Equipment:	$470,000

Key Technical Decisions

No key technical decisions were identified as being required to characterize DST wastes.



*DELAYED NEUTRON ACTIVATION ANALYSIS SYSTEM.
**DST WASTE CHARACTERIZATION COMPLETE.

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FIGURE VIII-4. Flow Diagram DST-3--Characterization.

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Technical Issue DST-4

RETRIEVAL

Statement of Issue

The technical issue is: What, if any, technology must be developed and demonstrated to assure that all the various kinds of liquid and solid wastes stored in double-shell tanks can be retrieved for subsequent disposal?

According to the reference plan (Figure 4-32), liquid and solid wastes in double-shell tanks will be retrieved and transferred to existing or new facilities for eventual immobilization and disposal. Although suitable methods for retrieving several of the different types of double-shell tank wastes are available, for certain other wastes (e.g., DSS, NCRW, NCAW, PFP, and TRU sludges for HWVP feed*) retrieval technology must be defined, developed, and demonstrated. Acquisition of this latter technology is the concern of this issue.

Scope

Development and demonstration of the technology for retrieval of certain double-shell tank wastes is required. Existing pumping techniques and facilities are considered to be adequate for retrieval and transport of HFW, CC, dilute supernatant liquors, and double-shell slurry feed (DSSF). These techniques and facilities may not be adequate, however, for retrieval of DSS, NCRW, NCAW and PFP waste, and TRU sludges being stored as feed to the Hanford Waste Vitrification Plant (HWVP). Retrieval techniques including hydraulic sluicing, high-shear pumping, air lifting, and pump mixing must be tested in pilot scale equipment. The effectiveness of hot water injection, chemical addition, ultrasonics, or other methods to increase the solubility of DSS for pumpout must also be demonstrated.

The scope of this issue also includes evaluation of the need for a chemical rinse for final tank cleanout.

Status

Onsite technology exists for pumping HFW, CC, DSSF, and dilute supernatant liquors. Mixing pumps have been used at Savannah River Plant to maintain solids suspensions. Sludges have been removed from tanks for cesium and strontium recovery by hydraulic sluicing. Retrieval characteristics of NCAW sludge are known, but equipment methods and requirements must be determined.

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*The TRU sludges for HWVP feed include stored TRU fractions resulting from B Plant pretreatment; i.e., washed NCAW and PFP sludges and solids from removal of TRU elements from CRW and CC.

Tasks to Close the Issue

The following tasks close the issue of retrieval of DST waste.

DST-4.1 Determine dissolution rates of DSS

Perform bench-scale tests with both synthetic and actual wastes to determine dissolution rates of DSS as well as other important retrieval-related properties (e.g., solids composition, rheological properties, particle size, etc.). ($70,000)

DST-4.2 Determine retrieval characteristics of NCRW

Perform bench-scale evaluations of synthetic and actual NCRW to determine the important retrieval properties (e.g., solids composition, rheological properties, particle size, etc.). Determine how these properties are effected by storage time and waste concentration. ($40,000)

DST-4.3 Determine retrieval characteristics of PFP waste

Perform bench-scale evaluations of synthetic and actual PFP waste to determine the important retrieval properties (e.g., solids composition, rheological properties, particle size, etc.). Determine how these properties are effected by changes within the PFP facility. ($40,000)

DST-4.4 Determine retrieval characteristics of HWVP feeds

Perform bench-scale evaluations of the TRU sludges being stored as feed for HWVP. Prepare and evaluate synthetic waste to simulate feed pretreatment. Provide technical information (i.e., solids composition, rheological properties, etc.) to provide suspension and retrieval method. ($25,000)

DST-4.5 Evaluate methods for waste tank cleanout

Determine the requirements for final tank cleanout, and evaluate appropriate methods for meeting cleanout requirements (e.g., oxalic acid as used at Savannah River Plant). ($50,000)

DST-4.6 Develop methods and equipment requirements for DSS retrieval

Conduct technology and engineering studies in conjunction with appropriate pilot plant and prototype work to define methodology and equipment requirements for removing DSS from DSTs. Determine methodology to transport retrieved waste to pretreatment (if necessary) for final disposal operations. ($200,000)

DST-4.7 Develop methods and equipment requirements for NCRW retrieval

Conduct technology and engineering studies in conjunction with appropriate pilot plant prototype work to define methodology and equipment requirements for removing NCRW from DSTs. Determine methodology to transport retrieved waste to final disposal operations. ($200,000)

DST-4.8 Develop methods and equipment requirements for NCAW retrieval

Conduct studies in conjunction with appropriate pilot plant and prototype work to define equipment requirements for removing NCAW from DSTs. Determine the solids suspension requirements during DST retrieval. ($150,000)

DST-4.9 Develop methods and equipment requirements for PFP waste retrieval

Conduct technology and engineering studies in conjunction with appropriate pilot plant and prototype work to define methodology and equipment requirements for removing PFP waste from DSTs. Determine methodology to transport retrieved waste to pretreatment or final disposal operations. ($200,000)

DST-4.10 Develop methods and equipment requirements for HWVP feed retrieval

Conduct technology and engineering studies in conjunction with appropriate pilot plant and prototype work to define methodology and equipment requirements for removing TRU sludges from DSTs. Determine methodology to transport retrieved waste to HWVP. ($150,000)

DST-4.11 Engineering study to determine if retrieval demonstration is necessary

Conduct an engineering study to determine if a retrieval demonstration is needed. If a demonstration is necessary, it should be performed using tank mockups or on an actual waste tank. ($55,000)

DST-4.12 Conduct waste retrieval demonstration (if necessary)

Design and fabricate equipment and demonstrate, if necessary, the retrieval of NCAW, DSS, CC, PFP waste, and HWVP feed from actual DSTs or from mocked-up tanks. ($1,900,000)*

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*Cost of this task would vary considerably depending on the scope (i.e., choice of waste(s) to be retrieved and actual tanks used versus mockups).

Flow Diagram

Figure VIII-5 illustrates the logical order of performing the tasks required to close the retrieval issue for DST wastes.

Costs to Close the Issue

Manpower:	$3,080,000
Materials:	$90,000
Capital Equipment:	$705,000

Key Technical Decisions

- DST-4 (1): Can retrieval methodology and equipment be used for more than one waste type?

A "yes" answer would thus eliminate the need to perform some, but not all, of the costs associated with tasks DST-4.6 through 4.10. The maximum total savings would be $900,000.

- DST-4 (2): Is it necessary to demonstrate retrieval from an actual DST(s) or from tank mockup(s)?

A "no" answer would eliminate the need to perform all or part of the costs associated with the following task:

- Conduct waste retrieval demonstration. ($1,900,000)

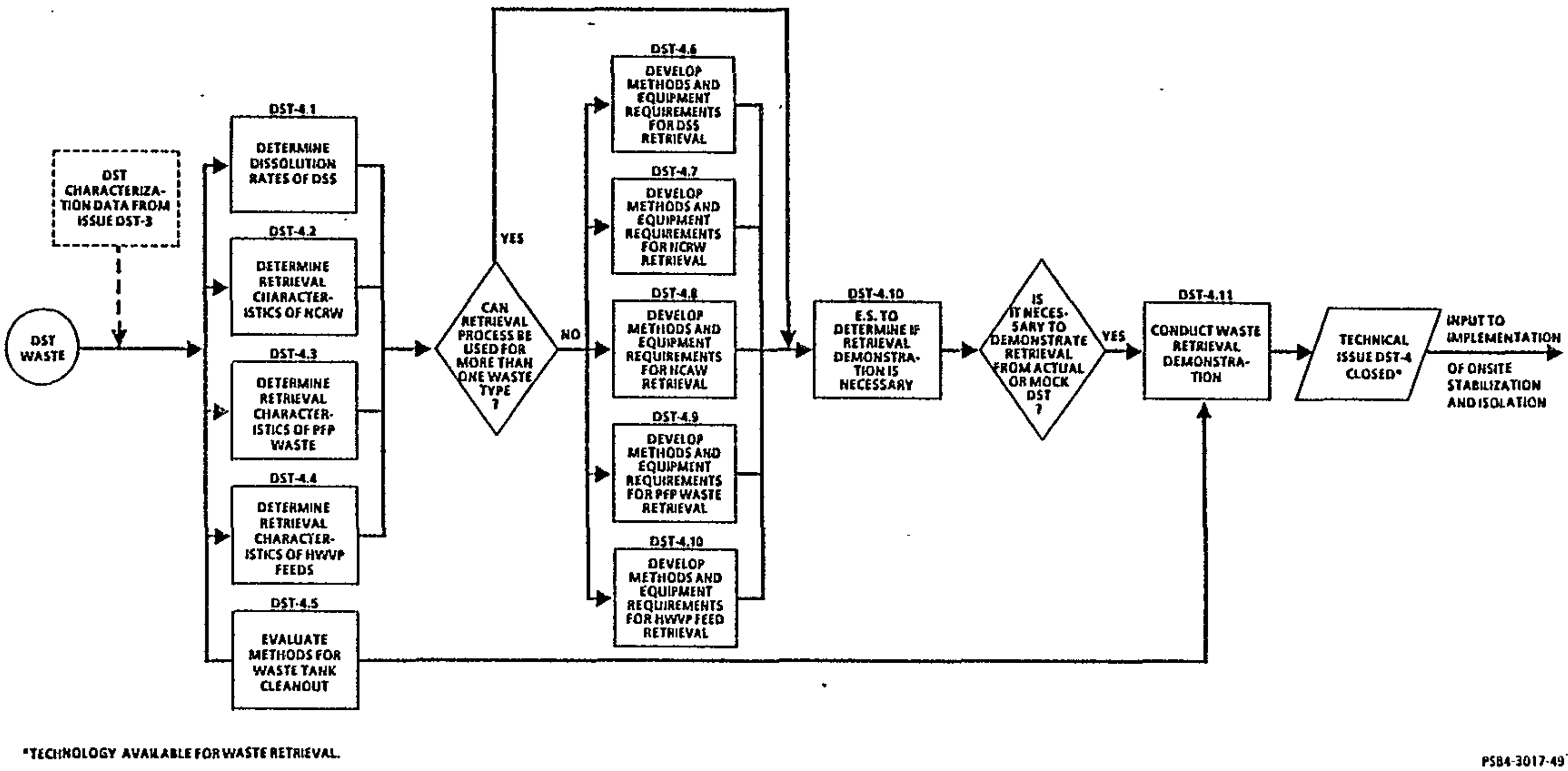

FIGURE VIII-5. Flow Diagram DST-4--Retrieval.

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Technical Issue DST-5

FEED PREPARATION

Statement of Issue

The technical issue is: Which of the existing and future double-shell tank wastes require pretreatment before immobilization, what are the required pretreatment steps, and what development effort is needed to provide the required feed preparation technology?

Many of the different types of wastes (existing and future) in double-shell tanks require some form of pretreatment (i.e., feed preparation) to make them suitable feeds to a grout facility or to the HWVP. This technical issue relates to the feed preparation technology which must be developed and demonstrated before immobilization and disposal of double-shell tank wastes can be accomplished.

Scope

Existing and future wastes stored in double-shell tanks will be feeds to the grout and vitrification facilities. Certain pretreatment steps will be necessary to ensure that the waste feeds exhibit appropriate physical and chemical properties to avoid upsets of the immobilization process and to produce acceptable products. Demonstrations of feed preparation technology will be performed in the headend of the B Plant facility. Feed preparation requirements differ considerably for DST wastes.

- Double-Shell Slurry and Complexed Concentrate.

  As a result of past B Plant operations, alkaline waste liquors in double-shell tanks (DSS and CC) contain significant concentrations of organic materials which form chemical complexes with TRU elements. The mobility of complexed radionuclides in Hanford soils/sediments is largely unknown. There is tentative evidence, however, to suggest that such species may have only limited mobility because of exchange of inert soil constituents (e.g., Ca, Fe) for radionuclides. Such exchange would allow fixation of radionuclides on soils and sediments. A more conservative assumption, however, is that complexed species will be unacceptably mobile and that organic complexes must therefore be destroyed. Regardless of radionuclide properties, destruction of organic materials may be mandated by regulatory criteria for permissible concentrations of organic materials and TRU elements in disposed radionuclide wastes. Development of methodology for destroying the organic complexants will thus likely be required. Other methodology for removing TRU elements from complexed alkaline waste liquors must also be addressed; particularly those methods that do not involve destroying the complexants (e.g.,

9 1 1 2 0 5 1 0 2 2 0

TRUEX process. See Technical Issue DST-8, TRU Removal from Aqueous PFP Waste). The TRU sludges resulting from destruction of organic complexants in CC and DSS are candidate feeds to the vitrification facility. The non-TRU DSS and CC will be immobilized in grout.

- Neutralized Current Acid Waste.

  The NCAW waste consists of sludges and supernatants resulting from neutralization of PUREX process current acid wastes (CAW). The NCAW sludge is a feed to the vitrification facility. Methodology for separating sludge and supernatant liquid in NCAW must be developed. The sludge must be washed to remove sulfate, aluminum, organic carbon and sodium salts. Methodology for washing the sludges must be developed, and process and equipment operating parameters must be determined. Methodology presently being developed at Savannah River Laboratories (SRL) for reducing sludge volume by washing with sodium hydroxide solutions to solubilize the aluminum fraction should also be addressed. Technology for reducing the amount of zirconium in NCAW sludge may also need to be developed. The need for zirconium removal is dependent upon results of sludge characterization studies (Technical Issue DST-3) and glass formulation studies (DST-6).

  The supernatant liquid from NCAW which contains significant amounts of ^{137}Cs constitutes feed to the grout immobilization facility. Disposal of the supernatant liquid as a thermally stable grout will require removal of radiocesium. Demonstrated ion exchange technology previously used at B Plant may be used for ^{137}Cs removal. Alternatively, it may be desirable to develop new technology. The resulting cesium crude concentrate will either be accumulated in B Plant for eventual purification and encapsulation or transferred to a HWVP feed tank for vitrification.

- Neutralized Cladding Removal Waste.

  The NCRW waste consists of sludges and supernatants resulting from neutralization of PUREX process CRW. The NCRW is a candidate feed to the grout facility. The supernatant liquid will contain significant concentrations of free fluoride which is known to retard the setting rate of grout. A method of pretreating the waste (e.g., precipitation of F^- by addition of Ca^{2+} or Mg^{2+}) may need to be developed. Methodology for treating CRW to remove TRU elements prior to neutralization is addressed in Technical Issue DST-1.

- Hanford Facility Waste

  The HFW is a LLW and does not require any feed preparation other than dilution or concentration prior to disposal as grout.

- Plutonium Finishing Plant

  Prior to 1989, acid PFP waste will be neutralized and the sludge portion of this waste will likely be vitrified in the HWVP. The non-TRU supernatant liquors will be immobilized in grout. Methodology for separating sludge and supernatant liquor in neutralized PFP waste needs to be developed. After 1989, TRU elements will be removed from acidic PFP waste (see Technical Issue DST-8); after neutralization, the resulting non-TRU sludge and supernatant will be converted to grout.

Certain physical properties (e.g., transport properties) and chemical properties of pretreated waste feeds to the HWVP are determined as part of task 4.4 in DST-4 (Retrieval).

Status

Extensive laboratory-scale studies of the destruction of organic complexants in alkaline solutions by reaction with ozone have been performed with both synthetic and actual alkaline waste liquors (Lutton, et al., 1979; Schulz, 1980). Previous bench-scale work and current laboratory studies indicate that hydrogen peroxide may be capable of oxidizing organic complexants in acid (pH <7) solutions.

Wet air oxidation and oxidation in supercritical water are also capable of destroying organic complexants. A study is being performed to recommend the most promising complexant destruction methods for further development.

Analyses of complexed concentrate waste in FY 1985 indicate that this waste is TRU and will require pretreatment to remove TRU components.

Laboratory studies show water washing of NCAW sludge can successfully reduce sodium salts, TOC, and sulfate to levels acceptable in glass formulations. Pilot scale testing to assess solids/liquid separations using a centrifuge for primary separation and inertial filtration for polishing has been initiated. Rheology studies of treated NCAW streams and of the treated NCRW streams are underway.

Tasks to Close the Issue

The following tasks close the issue of feed preparation of DST wastes:

DST-5.1 Develop low-level sulfate analysis (Completed)*

Develop reliable and accurate methods for analysis of low concentrations of sulfate in washed sludges. (Completed in FY 1985).

*Based on glass formulation studies (DST-6), the acceptable limit for sulfate in glass was increased considerably. Consequently, current analytical technology for sulfate was found to be acceptable.

DST-5.2 Determine migration behavior of long-lived radionuclides in soil

Conduct batch and column sorption tests with representative Hanford soils/sediments to establish mobility of complexed radionuclides (both before and after incorporation in grout) including ^{90}Sr, ^{137}Cs, ^{99}Tc, ^{14}C, ^{129}I, and TRU isotopes. This task includes soil transport studies in field lysimeters. It also includes determination of the uptake of complexed radionuclides by plants and biota. ($200,000)

DST-5.3 Develop methodology for solids/liquid separation in NCAW

Develop methodology for separation of sludge and supernatant liquors in NCAW. Determine optimum conditions for washing NCAW sludge to reduce sulfate, aluminum, TOC, and sodium salts to required levels. Define sludge washing equipment requirements. Inertial filtration methodology should be addressed as part of this study. ($675,000)

DST-5.4 Define feed campaign strategy

Conduct a study that evaluates cost and benefits of waste feed blending, waste stream segregation (if desirable) and associated impacts on tank farm capabilities, lag storage requirements, glass feed compositions, heat loadings, etc. Define the optimum strategy for blending and staging feeds to HWVP and grout. Establish effects of crucial feed preparation parameters (e.g., solids washing efficiency, etc.) on overall disposal system life cycle costs and operating strategy. ($250,000)

DST-5.5 Demonstrate reducing sludge volume (NaOH wash)

Conduct bench- and cold pilot plant-scale studies to establish conditions for reducing sludge volume by washing with sodium hydroxide solutions to solubilize the aluminum fraction. ($225,000)

DST-5.6 Develop methods to ensure NCRW is acceptable grout feed

If necessary, develop method for ensuring that NCRW is an acceptable feed to a grout process (e.g., precipitation of fluoride by addition of calcium; or by determining feasibility of blending with other waste types). ($175,000)

DST-5.7 Neutralized PFP waste feed preparation

Complete required appropriate laboratory and pilot-plant tests (e.g., washing studies) to develop technology needed to prepare neutralized PFP wastes for vitrification. ($100,000)

DST-5.8 <u>If necessary, demonstrate method for zirconium removal</u>

Conduct bench- and cold pilot plant-scale studies to develop methods of reducing zirconium concentrations in NCAW. Identify candidate processes through a scoping study before initiating the bench- and pilot-plant work. ($400,000)

DST-5.9 <u>Test and evaluate TRU removal methods</u>

Test and evaluate methodology for removing TRU elements (and if necessary, other long-lived isotopes such as ^{99}Tc, ^{14}C, and ^{129}I) from alkaline waste liquors that contain high concentrations of complexants. Methods that do not involve destroying the complexants should be particularly stressed. ($650,000)

DST-5.10 <u>Evaluate technical and economic feasibility of complexant destruction methods</u>

Review existing complexant destruction methods and recommend the most promising technologies for further development. Examples include ozonization, oxidation with hydrogen peroxide, wet air oxidation and oxidation in supercritical water. ($150,000)

DST-5.11 <u>Test and evaluate organic complexant destruction procedures</u>

On the basis that the destruction of organic complexants is required, conduct comprehensive engineering evaluations and associated laboratory and pilot-plant tests to define methodology (ozone, or alternative methods) for destroying organic complexants in existing Hanford alkaline waste slurries. ($1,600,000)

DST-5.12 <u>Conduct demonstrations in B Plant</u>

Conduct demonstration of feed preparation technology in B Plant including, where necessary, complexant destruction procedures, sludge washing, and cesium removal methods. Includes identification of process requirements, preparation of process flowsheets, engineering studies, and front-end engineering. Demonstrations may be performed on a continuing basis based on the results of product qualification studies. ($3,000,000)

<u>Flow Diagram</u>

Figure VIII-6 illustrates the logical order of performing the tasks required to close the issue of feed preparation of DST wastes.

Costs to Close the Issue

Manpower:	$7,420,000
Materials:	$1,100,000
Capital Equipment:	$1,240,000

Key Technical Decisions

- DST-5 (1): Is it necessary to remove zirconium from NCAW sludge?
- DST-5 (2): Is it necessary to destroy organic complexants in CC?
- DST-5 (3): Is it necessary to destroy organic complexants in DSS?
- DST-5 (4): Is it necessary to remove TRU components from DSS?

"No" answers to DST-5 (1) through DST-5 (5) would eliminate some but not all of the costs associated with the following tasks:

- Demonstrate method for zirconium removal. ($400,000)
- Evaluate technical and economic feasibility of ozonization for complexant destruction methods. ($150,000)
- Test and evaluate organic complexant destruction procedures. ($1,600,000)
- Test and evaluate TRU removal methods. ($650,000)
- Conduct demonstration in B Plant. ($3,000,000)

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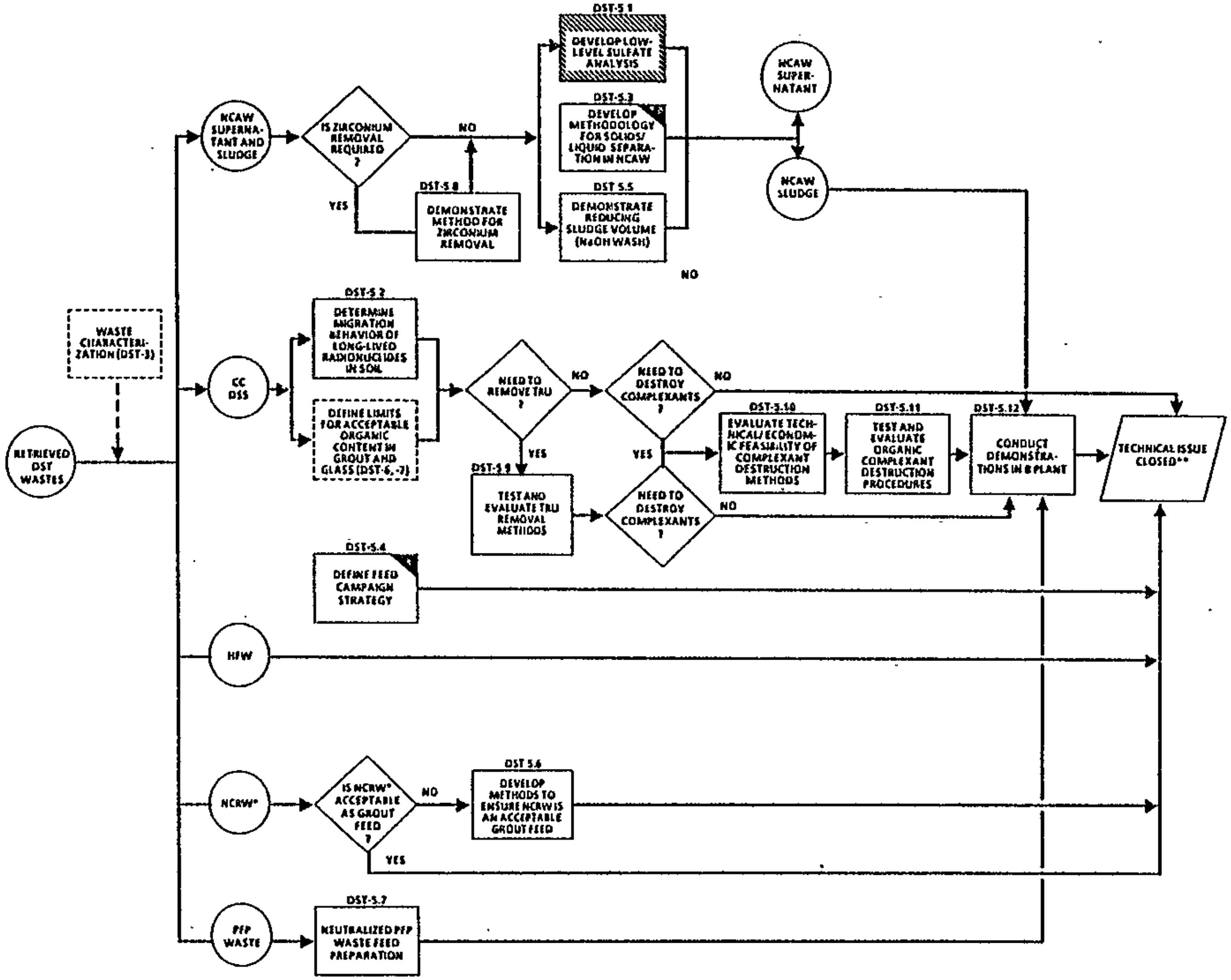
Lutton, T. W., D. M. Strachan, W. W. Schulz and L. J. Bollyky (1979), Ozone: Science and Eng., 1, 133.

Schulz, W. W. (1980), Removal of Radionuclides from Hanford Defense Waste Solutions, RHO-SA-51, Rockwell Hanford Operations, Richland, Washington.



* IT IS ASSUMED THAT, IF NECESSARY, REMOVAL OF TRU FROM CRW HAS BEEN ACCOMPLISHED (SEE TECHNICAL ISSUE DST-1).

** TECHNOLOGY AVAILABLE FOR IMPLEMENTATION OF GROUT IMMOBILIZATION OF CC, DSS, NCAW SUPERNATANT, AND HFW, AND VITRIFICATION OF NCAW.

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FIGURE VIII-6. Flow Diagram DST-5--Feed Preparation.

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Technical Issue DST-6

IMMOBILIZATION (GLASS)

<u>Statement of Issue</u>

The technical issue is: What process technology is missing and, therefore, must be provided to allow implementation of the reference plan for vitrification and disposal of Hanford high-level defense liquid wastes and TRU liquid wastes?

The reference plan for disposal of the wastes involves their conversion to a glass form suitable for disposal in a geologic repository. This issue involves the technical work necessary to adequately develop and demonstrate satisfactory vitrification technology which can be used to successfully implement the reference disposal plan.

<u>Scope</u>

Candidate double-shell tank wastes are not directly suitable as feeds to the HWVP. They require pretreatment (i.e., feed preparation) to make them compatible with subsequent processing. Waste pretreatment technology development requirements (e.g., sludge washing, cesium removal from supernatants, and complexant destruction) are described in technical issue DST-5. Waste pretreatment could result in the following waste streams as potential feeds to HWVP: sludge produced during neutralization of CAW and PFP waste, cesium concentrate resulting from removal of ^{137}Cs from supernatant liquors, TRU sludges resulting from removal of TRU elements from CRW, and TRU sludge resulting from destruction of organic complexants in CC and (if necessary) DSS.

It is likely that some of the pretreated high-level waste feeds will be blended in aging tanks prior to being fed to the HWVP. The technology required for determining the retrieval characteristics of these wastes (e.g., physical properties and chemical properties) is described in Technical Issue DST-4. This information will also facilitate HWVP design and glass formulation development.

The scope of work required for development of glass immobilization technology is as follows:

- Glass Formulation and Flowsheet Development.

  Glass formulations need to be developed to allow vitrification of NCAW sludge, sludge produced from neutralization of PFP waste, and TRU fractions resulting from removal of TRU elements from CRW and CC. It is likely that vitrification feeds would be blended; e.g., NCAW sludge/TRU fraction from CRW, and PFP sludge/TRU fraction from CC. Key waste components such as Cr, Zr, $SO_4^{=}$ and TOC must be evaluated to determine the maximum allowable concentrations in the feed and glass product. Waste components must be evaluated to determine the waste component variability limits which allow the production of an acceptable glass product and facilitate safe melter operation. While it is realized that no single formulation can accommodate all the candidate waste streams, the number of glass formulations required to handle the waste must be minimized. Detailed HWVP process flowsheets and facility flow requirements must also be identified.

- Equipment Design and Testing.

  Existing vitrification technology (from the West Valley Demonstration Project (WVDP) and Defense Waste Processing Facility (DWPF) will be reviewed to determine applicability to the HWVP. Wherever possible, existing technology or existing technology with appropriate modifications will be used as part of the HWVP. The majority of the effort associated with this task will involve modifications to the existing technology to meet Hanford-specific needs and testing of these modifications. The melter feed system, melter, and decontamination equipment all require evaluation to determine what modifications are required and the impact of the modifications on the overall HWVP.

- Facility and Support Services Design.

  The HWVP facility will be designed to vitrify waste using a hybrid remote process cell/canyon concept. Design of the following HWVP functions is required:

  - Melter, turntable, process off-gas system
  - Feed receipt and storage
  - Canister decontamination
  - Interim canister storage
  - Process sampling systems
  - Vessel vent system and closed-cycle cooling system
  - Facility heating, ventilation, and air conditioning system
  - Solid waste handling
  - Liquid waste handling
  - Liquid effluent (noncontaminated) handling

- Mechanical, electrical, utilities, and process support activities

- Equipment maintenance and decontamination

- Instrumentation and control.

- Waste Form Validation

  This issue also deals with development of the methodology required to assure that glass forms made in the HWVP will meet expected (and eventually established) mechanical, thermal, and radiolytic stability performance requirements. The HWVP reference borosilicate glass in a stainless steel canister, the waste form, must be validated in order to be accepted for emplacement in a geologic repository. The waste form validation activities include the following:

  - Definition of product and process parameters that are important to waste form quality

  - Qualification testing with HWVP reference glass to demonstrate the ability of the HWVP waste form formulation and process to produce a product that meets repository waste acceptance requirements prior to hot startup

  - Initiation, scheduling, and interpretation of results from melter runs to complement the qualification testing

  - Completion of NEPA documentation for HWVP waste form selection

  - Initiation and continuation of HWVP/repository intersite liaison activities

  - Cold testing activities to demonstrate the ability of the as-built HWVP to produce a waste form that meets repository waste acceptance requirements.

Status

Glass formulation and process flowsheet development for the blended NCAW sludge/CRW TRU fraction feed stream is currently underway. Initial pilot-scale melter and melter feed tests scheduled for FY 1985 will define a reference glass for future work. The HWVP Functional Design Criteria is scheduled for completion in third quarter FY 1985. The Preliminary Conceptual Design Report (PCDR) is scheduled to be issued during second quarter of FY 1986 and the Reference Conceptual Design Report will be issued during second quarter of FY 1987.

During FY 1984, an engineering study was performed to review the existing vitrification technologies developed for the U.S. Department of Energy at Savannah River, West Valley, and the Hanford Site for application to the HWVP. The study indicated that the DWPF design with certain modifications was most applicable for the next phase of the HWVP design. The study results will be used to develop conceptual design of HWVP during FY 1985.

Tasks to Close the Issue

The tasks to close the issue of waste immobilization in glass will be defined in detail in the HWVP Technology Plan, which will be issued September 30, 1985. The costs and specific tasks to close the issue will be more clearly defined at that time and the following description of tasks will be updated. The HWVP Technology Plan is being developed with a goal of maximizing the use of existing technology and minimizing new development efforts.

DST-6.1 Project management

Provide all project management, project control, data management, and configuration management support to the HWVP project. ($13,000,000)

DST-6.2 Complete glass formulation and process development flowsheets

Complete vitrification process development; includes glass formulation and process flowsheet development. This task includes interface with HWVP feed preparation work (Technical Issue DST-5). ($14,000,000)

DST-6.3 Provide technical system support

Provide technical support to vitrification development. Includes engineering studies and DWPF technology transfer, etc. ($15,000,000)

DST-6.4 Complete vitrification facility conceptual design

($7,500,000)

DST-6.5 Safety and environmental support

Provide safety review and planning support for the HWVP project. Provide environmental planning and documentation that will be integrated with the HDW-EIS. ($3,500,000)

DST-6.6 Equipment development tests

Evaluate vitrification technology using existing pilot-scale equipment. Includes evaluating capability of slurry feed system, melter processing parameters, appropriate off-gas treatment systems, etc. ($6,000,000)

DST-6.7 Equipment design and testing

Existing technology from DOE-funded programs that relate to the HWVP vitrification equipment will be reviewed and will be utilized where applicable. Equipment design modifications will be made as necessary to meet specific Hanford needs, and testing of these modifications will be performed if required. ($7,000,000)

DST-6.8 Waste form qualification

Develop methods and tests that assure that glass forms and/or packages meet shipping and handling criteria (e.g., drop tests), and the repository requirements relating to release of radionuclides and to thermal and mechanical stability. The scope of this task includes full qualification of the waste form. ($11,500,000)

DST-6.9 Training and certification

Provide training of operating personnel. ($10,000,000)

DST-6.10 Prestartup operations

Prepare and issue all process procedures, control plans, and operational test procedures (OTPs). Perform OTPs, and complete facility readiness review prior to startup. ($9,000,000)

Flow Diagram

Figure VIII-7 illustrates the logical order of performing the tasks required to close the glass immobilization issue. For clarity, certain capital expenditures (e.g., completion of definitive design and construction of the immobilization facility) are also indicated in the flow diagram.

Costs to Close the Issue

Costs to close the issue include those for program management and planning.

Manpower: $96,500,000
Materials: $15,000,000

Key Technical Decision

- Can selected SRP and WVDP technology be utilized for equipment design and development? For example:

  - Feed system design
  - Melter/turntable system
  - Defense Waste Processing Facility off-gas system
  - Canister storage system.

"Yes" answers would have the following impact: Utilization of selected technology for equipment design and development would eliminate some, but most likely not all of the costs associated with the following tasks:

- Equipment development tests. ($6,000,000)
- Equipment design and testing. ($7,000,000)

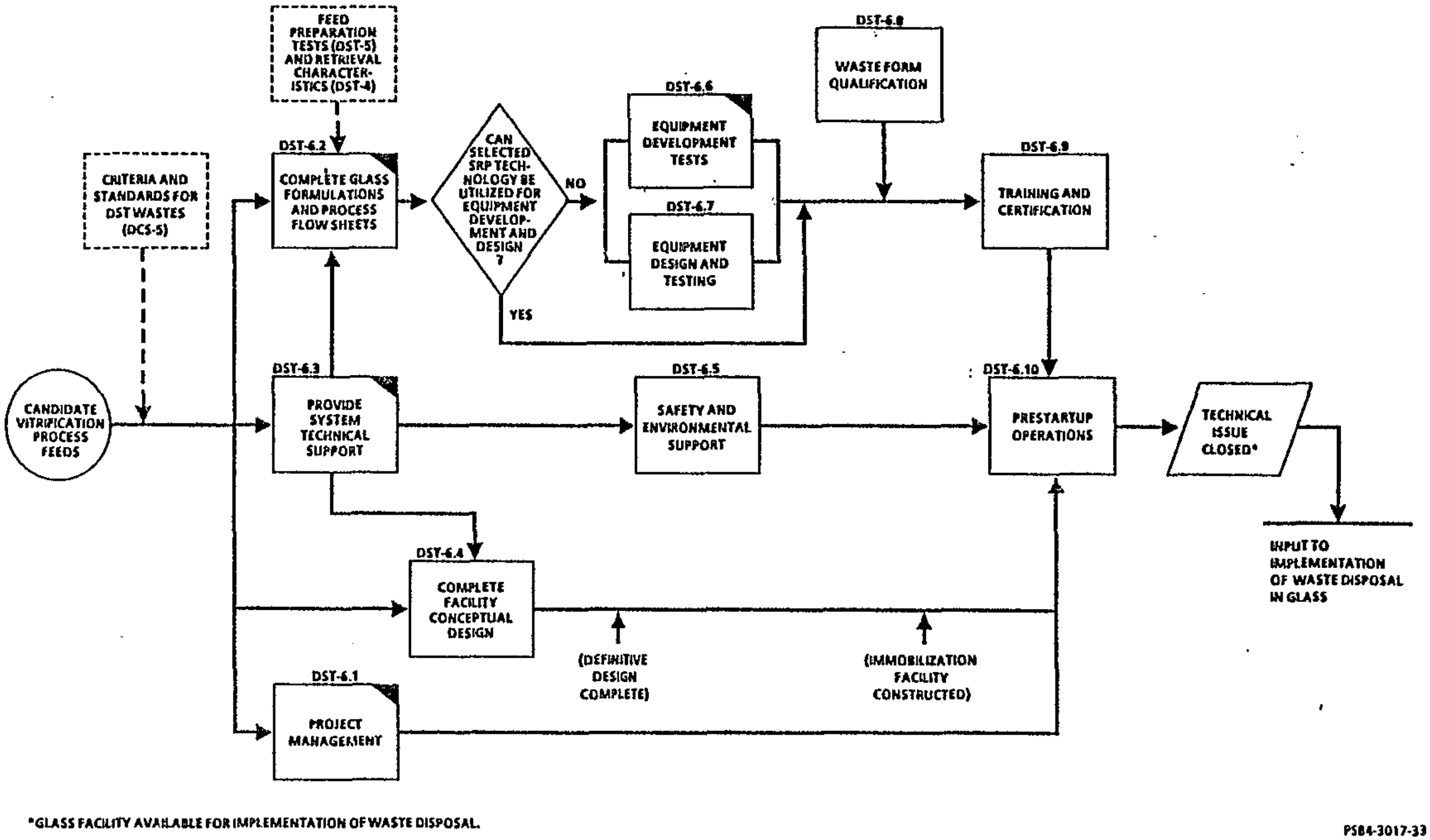

FIGURE VIII-7. Flow Diagram DST-6--Immobilization (Glass).

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Technical Issue DST-7

IMMOBILIZATION (GROUT)

<u>Statement of Issue</u>

The technical issue is: What technical tasks must be organized and completed to provide a firm technological basis for converting appropriate HSDW to a cementitious grout form?

The reference plan for disposal of alkaline waste liquors and slurries (existing and future) in double-shell tanks calls for their conversion to a cementitious grout form suitable for emplacement in a shallow land burial site. Technology for immobilizing these wastes in a grout form must be completely developed, demonstrated, and deployed to successfully implement the reference disposal plan. Acquisition of the needed technology in an orderly manner is the concern in this technical issue.

<u>Scope</u>

The strategy for development of grout forms for double-shell tank liquors provides for parallel development of technology and equipment. Initial startup of a Transportable Grout Facility (TGF) operating with low-level liquid waste as feed is targeted for November 1987. A second TGF may be built to help dispose of wastes generated in future operations. The need for this facility will be determined by the designation of future Hanford missions. Initial feeds to the TGF are phosphate and sulfate solutions [Hanford Facility Wastes (HFW)] from decontamination of the N Reactor. Ultimately double-shell slurries, double-shell slurry feeds, complexed concentrates, PUREX NCRW, and supernatant liquor (after removal of ^{137}Cs) resulting from neutralization of CAW and PFP waste, and spent sludge washes will be disposed of using the TGF. Requirements for retrieval and preparation of the wastes prior to fixation with grout are described in Technical Issues DST-4 and -5, respectively.

For development of grout fixation technology, the following scope of work must be completed.

- Define Formulations.

  An acceptable tailored grout formulation which addresses possible deleterious effects of chemical constituents (e.g., organic carbon, fluoride ion, sulfate ion, etc.) will be developed using synthetic and actual waste solutions. Characterization studies will be performed to assure that the tailored grout meets performance assessment requirements and all process, placement and disposal criteria. Acceptable formulations will be identified for each waste stream.

- Grout Preparation Technology and Testing.

  Grout formulation and characterization studies are currently being done by Oak Ridge National Laboratory (ORNL) and PNL personnel. To support an operational grout facility, ORNL grouting technology will be transferred to Hanford through PNL. The PNL will perform confirming studies. Methods for selecting the dry blend components and their proportions, mixing the dry solids and liquids, characterizing the resultant product grout and ensuring grout quality must all be capable of being performed by Rockwell scientists and engineers.

- Equipment Design and Testing.

  The Transportable Grout Equipment (TGE) is essentially the hardware which mixes the grout and pumps it to the disposal trench. Vendor contacts will be made and critical pieces of equipment tested prior to incorporation in detailed design. Proper consideration must be given to using commercially available equipment whenever possible. The assembled equipment will be appropriately tested to assure that quality grouts are produced and that the process is reliable.

- Facilities Design/Construction Support.

  Work performed under this task will develop the engineering studies, engineering required to proceed, fabricate and utilize the Transportable Grout Facility (TGF). Included are Functional Design Criteria (FDC), Conceptual Design Report (CDR), definitive design and field engineering and inspection.

- Grout Emplacement Technology

  Technology for grout emplacement must be developed. The disposal site must be established and the Grout Disposal Facilities (trenches and grout distribution piping system) must be designed and constructed.

- Safety and Environmental Documentation

  Performance evaluations, environmental studies and documentation, and analyses necessary to confirm the acceptability of planned applications of the TGF and grout formulations will be prepared. The scope of this work includes an evaluation of grout waste form performance to determine if chemical hazards exist based on regulatory requirements for mixed wastes.

Status

Disposal of radioactive wastes by grouting has been demonstrated at the ORNL Hydrofracture Facility. Initial laboratory tests at ORNL have demonstrated that candidate Hanford wastes can be immobilized in grout. A technical plan for a TGF to immobilize Hanford alkaline waste liquors and slurries has been formulated. The FDC, CDR, and engineering study are completed and approved.

The TGF and Shallow Land Disposal Site Technical Plans have been updated. The CDR for the burial trenches and grout pipeline has been approved by Rockwell and submitted to DOE for approval. Definitive design has been started on Project B-475, "Transportable Grout Facility," and B-492, "Shallow Land Disposal Site."

Initial grout flowability and pumpability tests were completed by PNL. The ORNL has nearly completed their HFW grout formulation work, and has started formulation work on NCRW; application of technology elements will be transferred from ORNL to Rockwell and PNL.

Tasks to Close the Issue

The following tasks close the issue of grout immobilization of Hanford wastes.

DST-7.1 Select candidate feed streams (Completed)

Establish additional waste feed streams based on applicable regulatory requirements for shallow land disposal, feed availability, performance studies, etc.

DST-7.2 Develop grout formulations

Develop suitable grout formulations for each waste stream using synthetic and actual wastes. ($2,120,000)

DST-7.3 Characterize grout forms to ensure disposal requirements are met

Characterize grout to assure that process, placement, and disposal requirements are met. Grout must exhibit desired rheology, set times, and disposal system acceptable release rates, thermodynamic stability, etc. Release mechanisms will be identified. Releases will be related to the waste form characteristics site hydrogeology, etc. Models that quantify the release will be developed as input to performance assessments. ($2,460,000)

DST-7.4 <u>Select location for disposal site</u> (Completed)

A study must be completed to select an acceptable location of a grout disposal site; construction costs, design costs, safety and environmental, accessibility, utility requirements, etc. must all be properly considered. (Completed in FY 1984)

DST-7.5 <u>Provide environmental and safety documentation</u>

Provide appropriate documentation including environmental assessments, safety analysis reports, and performance assessments to support facility startup with Hanford Facility Waste. ($2,510,000)

DST-7.6 <u>Complete baseline characterization of disposal site</u>

Establish an environmental baseline for the grout shallow land disposal site to determine the effects, if any, of grout disposal. ($830,000)

DST-7.7 <u>Equipment development and testing</u>

Test grout preparation equipment to assure that acceptable quality grouts are produced; provide transfer of ORNL technology for grout preparation and testing through PNL to Rockwell. ($300,000)

DST-7.8 <u>Develop capability for controlling and analyzing grout product quality</u>

Establish capability for analytical support to a grout facility to control and analyze grout product quality. ($330,000)

DST-7.9 <u>Provide design, construction support</u>

Conduct engineering studies required to procure, fabricate, and utilize the TGF. Included are FDC, CDR, definitive design, etc. This task includes Quality Assurance support. ($2,560,000)

DST-7.10 <u>Design grout emplacement facilities</u>

Design and construct the grout disposal trenches and/or caissons and the grout distribution piping system. ($500,000)

DST-7.11 <u>Operational procedures and training</u>

As part of preparation for cold-testing of the grout facility, operating procedures must be prepared and operating personnel must be formally trained. ($800,000)

DST-7.12 <u>Cold test grout facility</u>

Perform appropriate prestartup tests to assure that quality grout is produced and the process is reliable. Modify equipment and/or facility as needed. ($2,300,000)

Flow Diagram

Figure VIII-8 illustrates the logical order of performing the tasks required to close the grout immobilization issue.

Costs to Close the Issue

Manpower:	$14,700,000
Materials:	$350,000
Capital Equipment:	$120,000

Key Technical Decisions

No key technical decisions were identified as being required for development of grout immobilization technology.

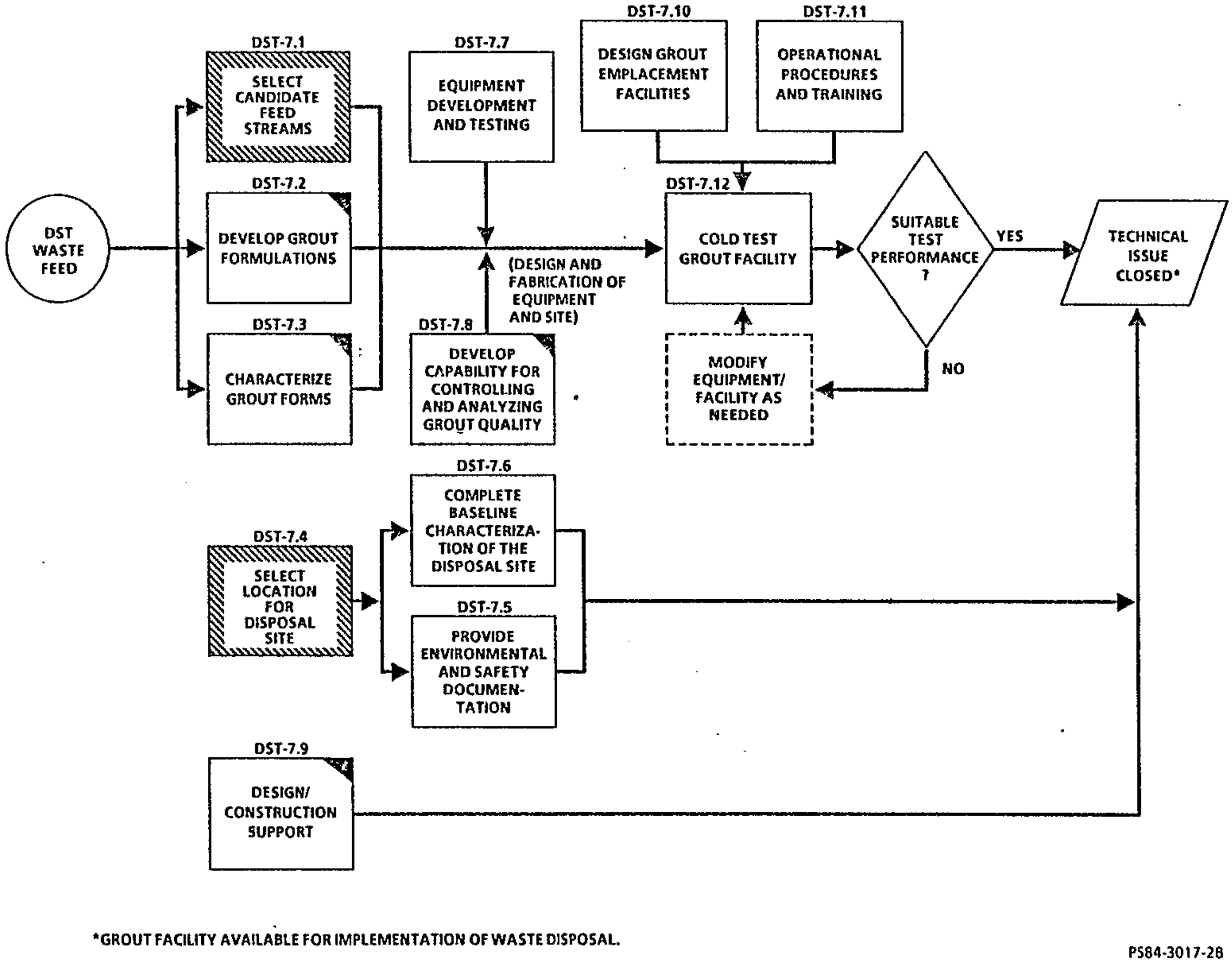

FIGURE VIII-8. Flow Diagram DST-7--Immobilization (Grout).

Technical Issue DST-8

TRANSURANIC REMOVAL FROM AQUEOUS PLUTONIUM FINISHING PLANT WASTE

Statement of Issue

The technical issue is: What separation processes need to be developed and tested to provide reliable and demonstrated technology for making PFP aqueous waste a non-TRU (i.e., <100 nCi/g) waste?

Availability and implementation of technically and economically feasible TRU removal processes could significantly impact the disposal location (geologic repository versus near-surface disposal), and the disposal costs of stored and future PFP aqueous wastes. This issue relates to identification and specification of the engineering and laboratory studies that should be performed to define practicable TRU element removal technology.

Scope

This issue relates to removal (in 1989 and thereafter) of ^{241}Am and plutonium from both current acid PFP aqueous waste and neutralized PFP waste (sludge) stored in double-shell tanks. The reference plan for the latter wastes (Fig. VIII-1) involves removal of PFP sludge from double-shell tanks, washing or other pretreatment (Technical Issue DST-5), and vitrification. Future economic consideration may, however, mandate acidic dissolution of retrieved PFP sludge and subsequent recovery of TRU values; technology for such separations is addressed in this technical issue.

The scope of the needed technology includes the following:*

- Determination of the composition and properties of acidic PFP aqueous waste and PFP sludges

- Bench- and pilot-plant scale studies with simulated and actual PFP waste solutions and sludges to develop and demonstrate technically feasible processes (i.e., solvent extraction, solids-liquid separation, sludge dissolution, etc.) to reduce the total TRU element concentrations to or below 100 nCi/g

- Engineering studies to define plant-scale TRU removal process operability requirements and economic feasibility.

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*Tasks to develop technology requirements for characterization, retrieval, and pretreatment (if necessary) of PFP waste stored in DSTs are addressed in Technical Issues DST-3, DST-4, and DST-5, respectively.

Status

The TRUEX solvent extraction process invented at Argonne National Laboratory (Vandegrift, et al., 1984) appears particularly well suited to efficient removal and recovery of Pu from acidic (HNO_3) PFP wastes. Partitioning and recovery of ^{241}Am for purification or conversion to a solid waste is also possible if desired. By adjustment of flowsheet conditions, the TRUEX process appears capable of yielding relatively pure plutonium and americium fractions. Bench-scale tests of the TRUEX process with simulated acidic PFP aqueous waste are currently in progress at the Argonne National Laboratory. Scoping studies with actual PFP wastes have been conducted at Hanford.

There is considerable experience at Hanford in HNO_3 treatment of PUREX sludges to recover ^{90}Sr, which may be applicable to solubilization of TRU elements in stored PFP sludges. Techniques (e.g., oxalic acid treatment) developed at the Savannah River Laboratory may also be useful in solubilizing TRU elements in PFP sludges. Solid-liquid separation technology being developed as part of the resolution of Technical Issue DST-5 will likely be applicable to removal of TRU-containing solids from both current PFP aqueous waste and acidified PFP sludges. Precipitation (e.g., oxalate) and calcination technology for converting a purified americium nitrate solution to oxide for beneficial use is at hand.

Tasks to Close the Issue

The following tasks close the issue of technology for removal of TRU elements from PFP aqueous wastes:

DST-8.1 TRUEX process engineering overview

This task involves engineering evaluations of TRUEX process technical feasibility, economics, and scheduling. Also included in this task is preparation of required design and safety documents. ($250,000)

DST-8.2 Nitric acid dissolution of PFP sludges

Conduct bench-scale tests with actual PFP sludges to develop and demonstrate suitable technology for solubilizing such sludges to prepare nitrate-based solutions for subsequent TRU removal steps. ($70,000)

DST-8.3 Characterize acidic PFP waste solutions

Perform appropriate bench-scale tests and analyses to establish the composition and properties of actual current acid PFP waste and of actual acidified PFP sludge. Special emphasis will be given to determining the amount, TRU content, and properties (e.g., particle size, etc.) of solids in such waste solutions. (Composition and properties of stored PFP sludges prior to acidification will be determined by tasks DST-3.5 and DST-3.6, Technical Issue DST 3). ($50,000)

DST-8.4 Solids-liquid separation technology

Develop and demonstrate technology for removing TRU-containing solids from acidic PFP wastes. This task will involve engineering studies to identify and evaluate candidate solids-liquid separations schemes followed by bench- and pilot-plant-scale tests with actual acid wastes. ($250,000)

DST-8.5 TRUEX process development--simulated waste

Complete TRUEX process development tests with simulated PFP wastes spiked with plutonium and americium. Such tests will include both batch and multistage centrifugal contactor runs to determine overall process performance to establish key controlling process parameters, and to develop a detailed reference TRUEX process flowsheet. ($250,000)

DST-8.6 TRUEX process tests--actual waste

Plan and perform both batch and continuous countercurrent (centrifugal contactor) TRUEX process tests with actual acid PFP waste solutions. These tests will have several important objectives: (1) to confirm and optimize reference TRUEX process flowsheet TRU removal and separation performance; (2) to obtain hydraulic data needed for detailed design of engineering-scale contactors; and (3) to prepare americium and plutonium product solutions for further experimental work. ($490,000)

DST-8.7 TRUEX process solvent degradation and cleanup tests

Devise, perform, and evaluate chemical and radiolytic degradation tests to establish the useful life of the TRUEX process solvent and the required inventory replacement. This task also involves experimental work to define appropriate methods for determining TRUEX solvent quality and for cleaning degraded solvent. ($200,000)

DST-8.8 Americium Product Conversion/Disposal

Appropriate product conversion/disposal studies will be conducted to evaluate and test methods for converting the impure TRUEX process americium product to a solid form suitable either for prolonged interim storage or geologic disposal. ($120,000)

Flow Diagram

Figure VIII-9 illustrates the logical order of performing the tasks required to close the technical issue of TRU removal from PFP wastes.

Costs to Close the Issue*

Manpower and Materials:	$1,680,000
Capital Equipment:	$400,000

Key Technical Decisions

No key technical decisions were identified as being required to close the issue of TRU removal from PFP wastes.

*Construction and installation of a TRUEX process prototype unit in the PFP is estimated to cost about $6.1 million. Of this total, $1.68 million are costs associated with completion of TRUEX process technology.

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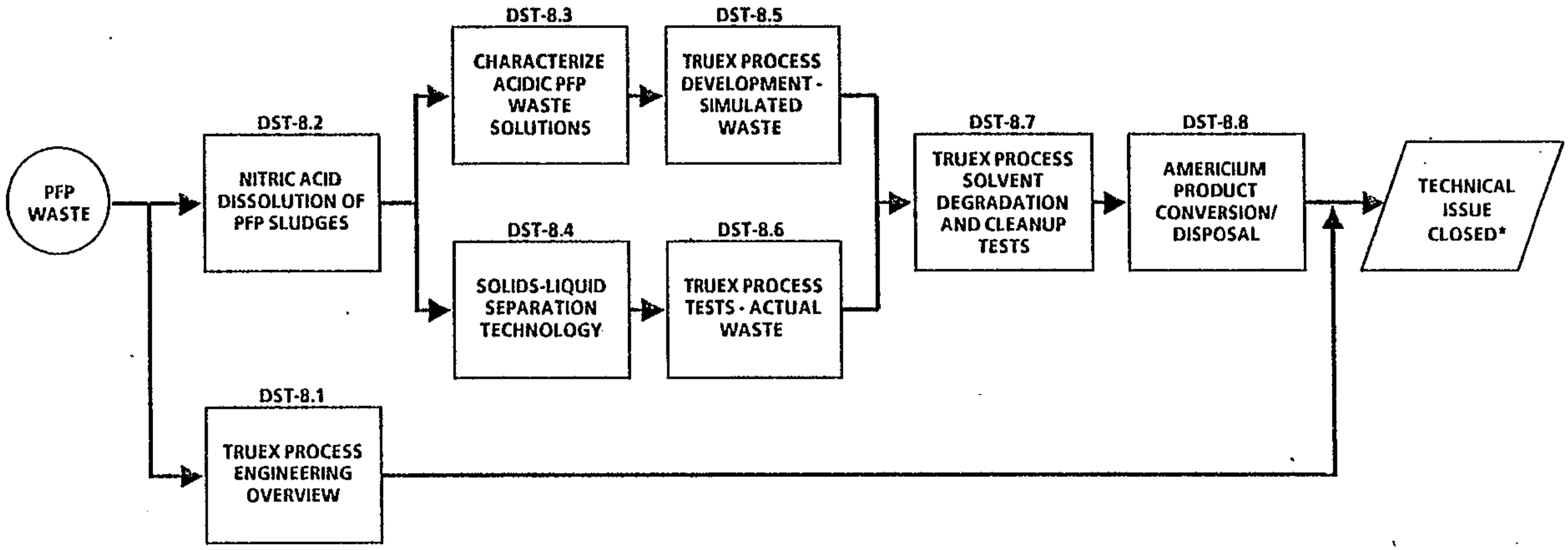

*TECHNOLOGY FOR IMPLEMENTATION OF TRU REMOVAL IS AVAILABLE.

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FIGURE VIII-9. Flow Diagram DST-8--TRU Removal from Aqueous PFP Waste.

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IX. CAPSULES

A. REFERENCE DISPOSAL PLAN

The reference plan for disposal of capsules ($^{137}CsCl$ and $^{90}SrF_2$) is shown in Figure IX-1. Table IX-1 lists significant dates associated with disposal of encapsulated waste.

B. SCHEDULE

Schedules for resolving the technical issues are shown in Figure IX-2.

C. COST SUMMARY

Table IX-2 summarizes the costs associated with development of technology required to close the capsule technical issues.

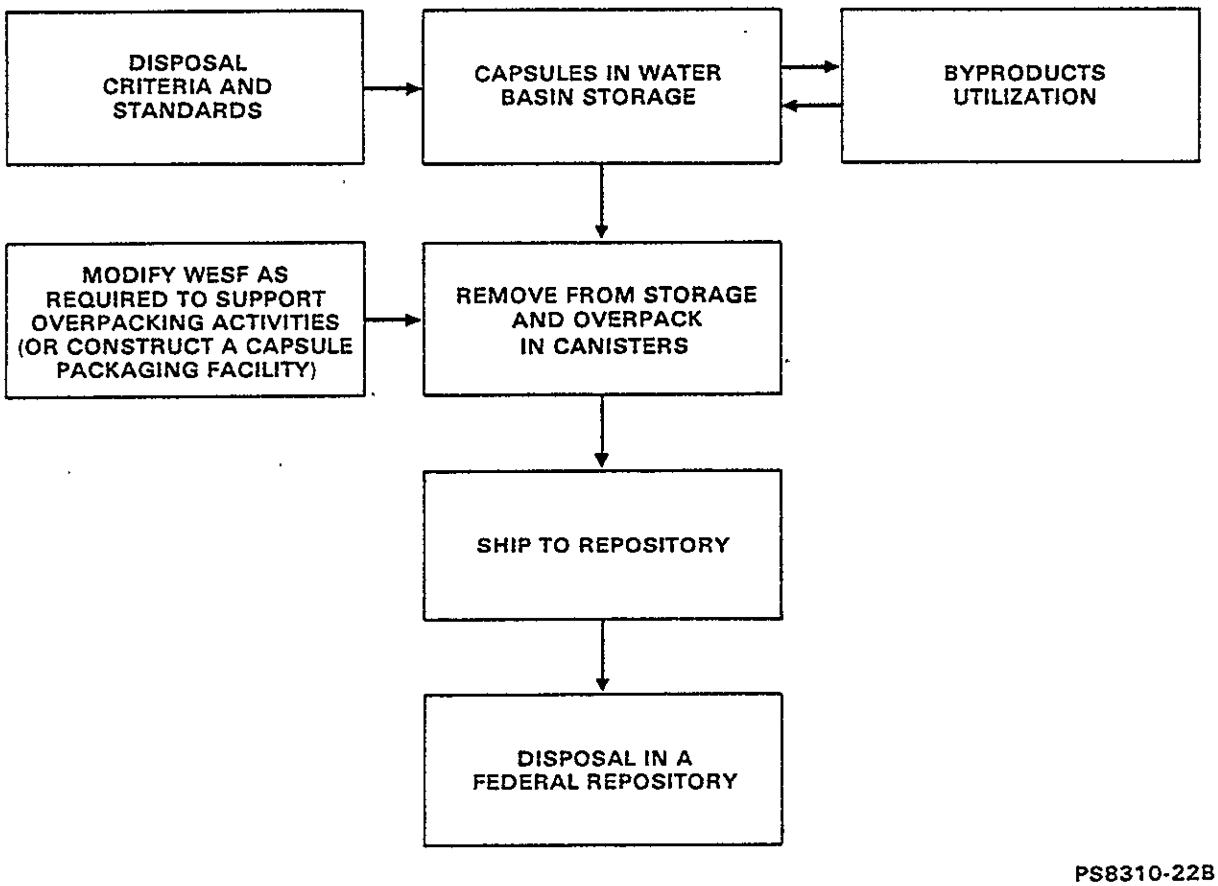

FIGURE IX-1. Reference Plan for Disposal of Capsules.

TABLE IX-1. Significant Hanford Waste Management Dates--Capsules.

FY 1985	Complete encapsulation of ^{90}Sr
FY 2001	Complete construction of capsule packaging facility [or complete Waste Encapsulation and Storage Facility (WESF) modifications]
FY 2001-2005	Overpack and transport capsules to repository

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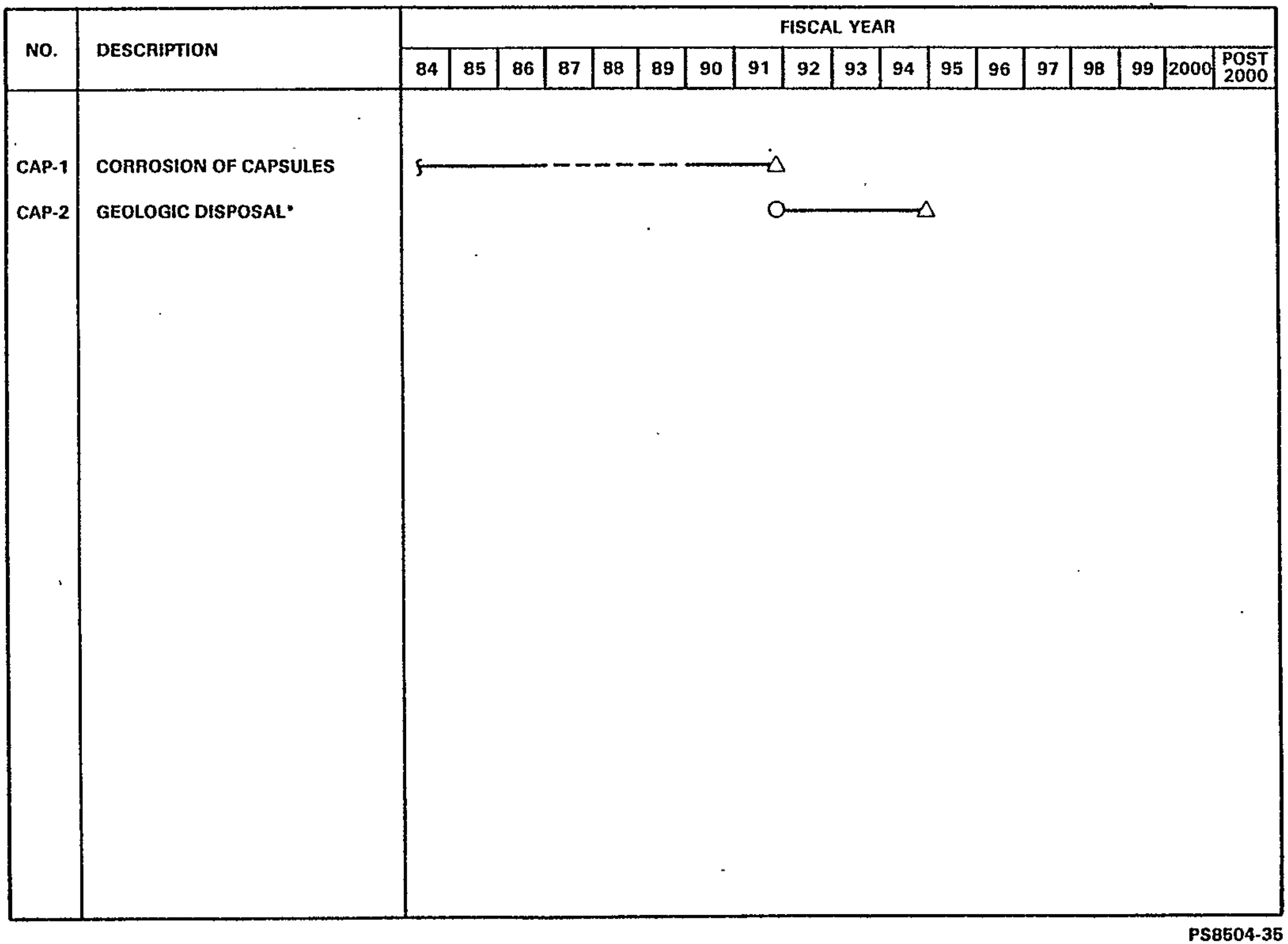

FIGURE IX-2. Schedules for Resolving CAP Technical Issues.

TABLE IX-2. Estimated Technology Development Costs--Capsules.

Technical issue		Estimated costs ($1,000)			
Identification symbol	Title	Manpower	Material	Capital equipment	Total
CAP-1	Capsule Corrosion	$ 650	$100		$ 750
CAP-2	Geologic Disposal	1,150	150		1,300
	TOTAL (rounded)	$1,800	$250		$2,050

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Technical Issue CAP-1

CORROSION OF CAPSULES

Statement of Issue

The technical issue is: At the high temperatures which will prevail during interim capsule storage or final disposal, will the walls of the inner 316L stainless steel capsules be excessively corroded by reaction with $^{137}CsCl$ or normal impurities found in the WESF product?

The compatibility of cesium chloride with the 316L stainless steel inner capsule at the temperatures expected during either interim (water basin) storage or final disposal is unknown and is therefore a technical issue requiring resolution. Reactions, if any, of $^{137}CsCl$ WESF product with 316L stainless steel at the elevated temperatures must be evaluated to support predictions of long-term capsule integrity.

Scope

In potential final disposal configurations, the temperature at the interface between the waste and the stainless steel may be as high as 450 ^{o}C. Corrosion rates at these temperatures must be evaluated. The temperature dependence of the corrosion rates must also be defined to assess safety issues for storage of capsules in water basins.

This issue includes determination of the compatibility of cesium chloride and 316L stainless steel at temperature regimes typical of final disposal, byproducts utilization, and water basin storage. The individual tasks include the following:

Final Disposal

- Determine physical properties of cesium chloride.
- Experiments with simulated encapsulated wastes to determine effects of impurity variations.
- Chemical analysis of cesium chloride product.
- Metallographic examination of cesium chloride capsules from elevated temperature tests.

Byproducts Utilization

- Assess temperature history for typical irradiator uses.
- Metallographic examination of inner walls of capsules after irradiator use.

Water Basin

- Metallographic examination of older capsules in water basins.
- Formulation of a periodic capsule inspection plan.

Status

A revised program plan was written to reflect additional testing, including justification for water basin and byproducts utilization capsule assessment.

Physical properties of cesium chloride and a thermodynamic analysis of the waste product with normal impurities in contact with stainless steel have been completed. Metallographic results have been obtained from five radioactive test capsules from the elevated temperature tests representing test periods from zero (baseline) to two years. Test capsules to be analyzed after three and four years remain in high temperature testing.

Samples were obtained in FY 1984 for metallographic evaluation of 18 capsules from the water basin. Samples from these capsules have been transferred from the Waste Encapsulation and Storage Facility (WESF) to PNL in the 300 Area for analysis. Metallographic examination of the two capsules used by Sandia Laboratories prototype irradiator has been completed.

Tasks to Close the Issue

The following tasks close the issue of capsule corrosion:

CAP-1.1 Formulate a plan for periodic inspection of capsules (Completed)

Formulate a plan for periodic inspection of capsules at pool-cell conditions. (Completed in FY 1984)

CAP-1.2 Perform capsule temperature testing

Complete elevated temperature testing and destructive analysis of three and four year test capsules. ($220,000)

CAP-1.3 Perform nonradioactive (impurity) capsule testing

Perform experiments with simulated encapsulated wastes to determine the effects of impurity variations. ($180,000)

CAP-1.4 Perform capsule metallographic testing

Perform metallographic examination of capsules from water basin storage. ($175,000)

CAP-1.5 Analyze byproduct capsules

Analyze capsules used in byproducts utilization activities. (Funded by Sandia Irradiator Program)

CAP-1.6 Predict long-term capsule integrity

Based on results of elevated temperature tests, periodic inspection, etc., complete an analysis predicting the long-term integrity of the capsules. ($75,000)

Flow Diagram

Figure IX-3 illustrates the logical order of performing the tasks required to close the capsule corrosion issue for encapsulated wastes.

Costs to Close the Issue

Manpower: $650,000
Materials: $100,000

Key Technical Decisions

No key technical decisions were identified as being required to assure safe interim storage of capsules in water basins.

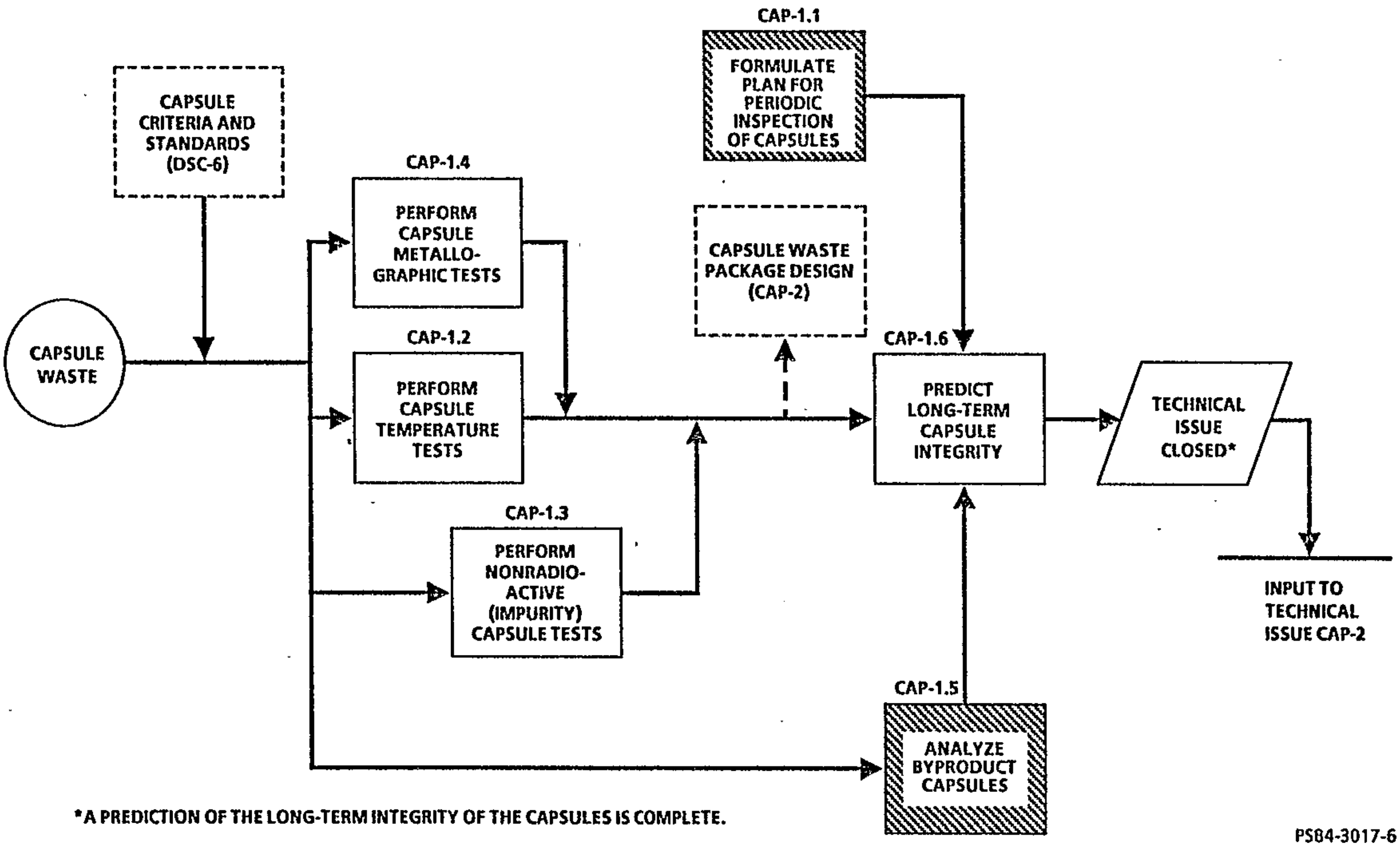

FIGURE IX-3. Flow Diagram CAP-1--Corrosion of Capsules.

Technical Issue CAP-2

GEOLOGIC DISPOSAL

Statement of Issue

The technical issue is: What technical tasks, e.g., engineering studies, etc. must be completed to assure that overpacked capsules containing $^{137}CsCl$ or $^{90}SrF_2$ can be disposed of in a deep geologic repository?

Cesium and strontium capsules must meet all of the criteria for disposal in a repository excavated in deep geologic strata. This technical issue focuses on definition and development of technology for ensuring the required compliance.

Scope

Formal waste form acceptance criteria for the various candidate nuclear waste repository strata have not been published. General guidelines for such criteria are, however, available from repository developers and from regulatory bodies (e.g., NRC, 1983). This issue deals with development of the methodology required to assure that overpacked cesium and strontium capsules will meet expected (and eventually established) repository performance requirements.

As part of this issue, thermal limitations for potential emplacement configurations of capsules must be addressed more fully. Heat loading limitations in a repository may be imposed by the geologic formation or by the capsule material/waste form interactions. The need for a thermal decay storage period before placing capsules into a geologic repository should be evaluated. An engineering study is required in which thermal analyses of various repository emplacement schemes for potential cooling periods are evaluated.

Another concern is the overpack design for the capsules. Previous conceptual designs were based on thin walled overpacks requiring extensive shielding for handling and complex shipping arrangements. A massive self-shielded overpack will be evaluated as part of this issue. These two overpack concepts should be compared in an engineering study to identify cost/benefit advantages inherent in each design.

The scope of this issue also includes evaluation of appropriate alternative concepts for implementation of geologic disposal of encapsulated wastes. The option of converting the encapsulated waste to borosilicate glass in the HWVP will be addressed.

Status

A geologic repository in which capsules can be disposed will not be available until the late 1990's at the earliest. Hence, firm waste form acceptance and certification criteria will not be available for several years.

A preconceptual design for a thin walled canister and costs to implement its use for high level waste capsules were presented earlier (Rockwell, 1980). A feasibility study of a massive steel overpack, which includes rough cost estimates, has also been completed. The feasibility study showed that massive cast steel overpacks would be effective for dry surface storage and near surface disposal of waste capsules. A technology program plan has been completed detailing the tasks required for field tests of prototype overpacks.

Tasks to Close the Issue

The following tasks close the issue of geologic disposal of encapsulated wastes:

CAP-2.1 Identify repository certification requirements

Determine potential, preliminary and final waste form acceptance and certification requirements for various repositories. ($125,000)

CAP-2.2 Evaluate self-shielded overpack

Perform cost/benefit study to compare design of thin walled overpacks with massive self-shielded overpack. ($60,000)

CAP-2.3 Design waste package (upgrade-overpack)

Design capsule waste package (upgrade-overpack) which will comply with several repository preliminary and final acceptance criteria. ($400,000)

CAP-2.4 Develop repository waste-package performance tests

Develop methods and tests which assure that capsule waste packages meet repository requirements relating to product performance. ($340,000)

CAP-2.5 Determine the cost effectiveness of thermal cooling

Assess the cost effectiveness of a thermal cooling period before emplacement into final disposal. ($65,000)

CAP-2.6 Evaluate alternative geologic disposal concepts

Conduct an engineering study of appropriate alternative concepts (e.g., incorporation of encapsulated waste in glass) for implementation of geologic disposal of encapsulated wastes. ($160,000)

Flow Diagram

Figure IX-4 illustrates the logical order of performing the tasks required to close the geologic disposal issue for encapsulated wastes.

Costs to Close the Issue

Manpower: $1,150,000
Materials: $150,000

Key Technical Decision

- CAP-2 (1): Is the waste package design acceptable for disposal in a geologic repository?

A "yes" answer would eliminate the need to perform the following tasks:

- Design waste package (upgrade - overpack). ($460,000)
- Develop repository waste-package performance tests. ($340,000)

The total savings would be $800,000.

Bibliography

NRC (1983), "Disposal of High-Level Radioactive Waste in Geologic Repositories," Title 10, Code of Federal Regulations, Part 60, U.S. Nuclear Regulatory Commission, Washington, D.C.

Rockwell (1980), Technical Aspects of Long-Term Alternatives for High-Level Waste at the Hanford Site, RHO-LD-146, Rockwell Hanford Operations, Richland, Washington.

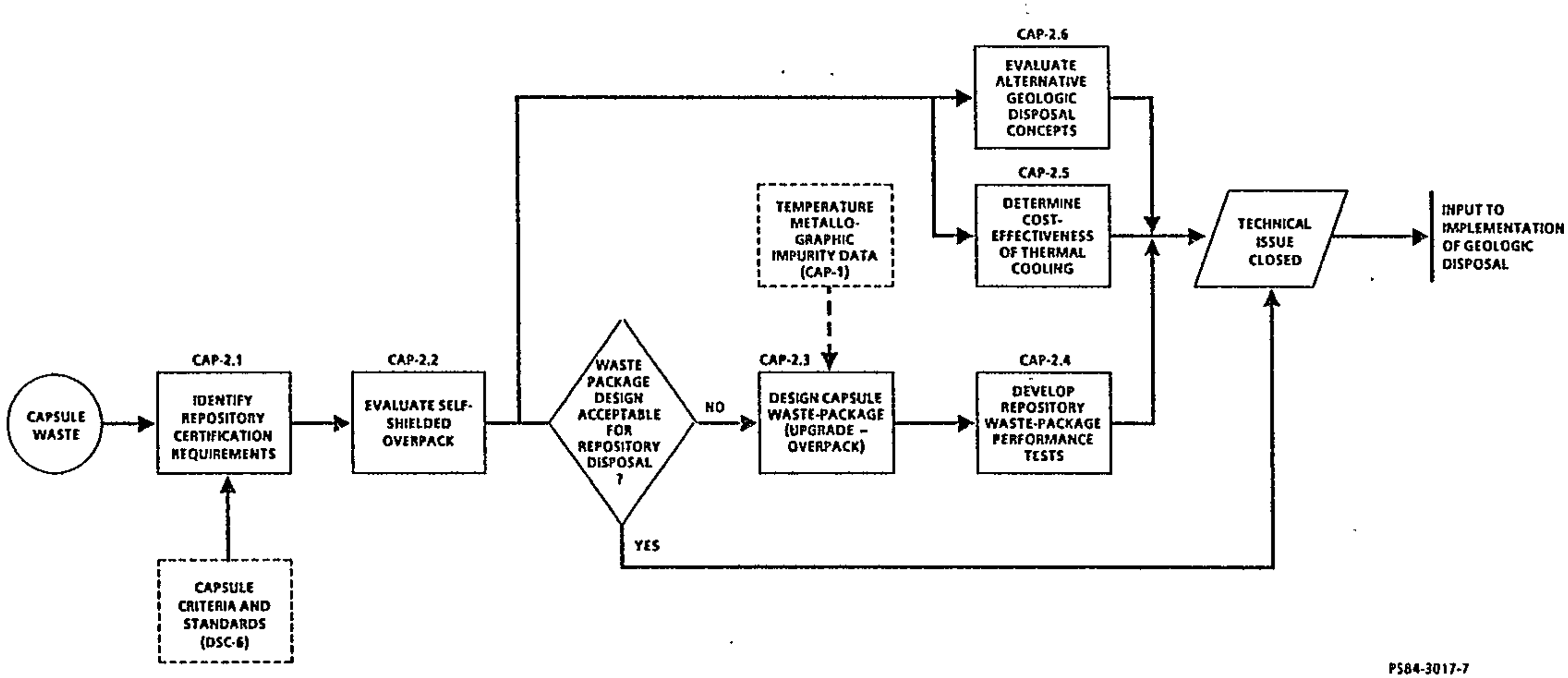

FIGURE IX-4. Flow Diagram CAP-2--Geologic Disposal.

X. STORED AND NEW SOLID TRANSURANIC WASTE

A. REFERENCE DISPOSAL PLAN

The reference plan for disposal of stored and new solid transuranic (TRU) waste is shown in Figure X-1. Table X-1 lists significant dates associated with disposal of the TRU waste.

B. SCHEDULE

Schedules for resolving the technical issues are shown in Figure X-2.

C. COST SUMMARY

Table X-2 summarizes the costs (escalated through FY 1987) associated with development of technology required to close the TRU technical issues.

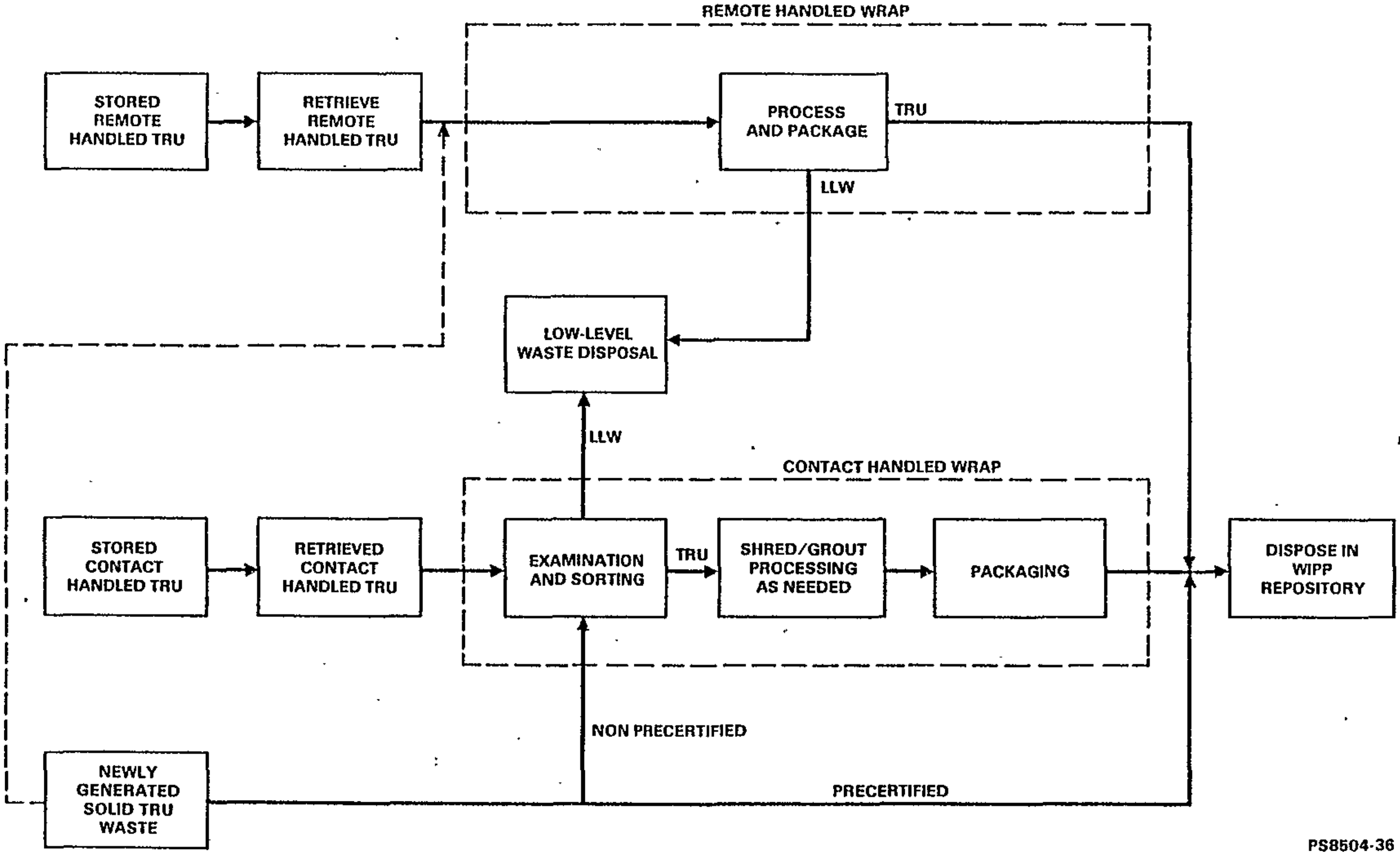

FIGURE X-1. Reference Plan for Disposal of Stored Solid TRU Wastes.

TABLE X-1. Significant Hanford Waste Management Dates--
Stored and New Solid TRU Waste.

FY 1985	Start TRU Storage and Assay Facility (TRUSAF) assay operations
FY 1993	Complete CH-WRAP construction and cold test operations
FY 1994	Begin CH-WRAP operations
FY 1996	Complete caisson retrieval facility design and construction
FY 1996	Complete RH waste recovery and processing facilities design and construction
FY 1994-2015	Conduct recovery, processing and disposal operations for CH-TRU waste
FY 1996-2001	Conduct RH waste disposal operations

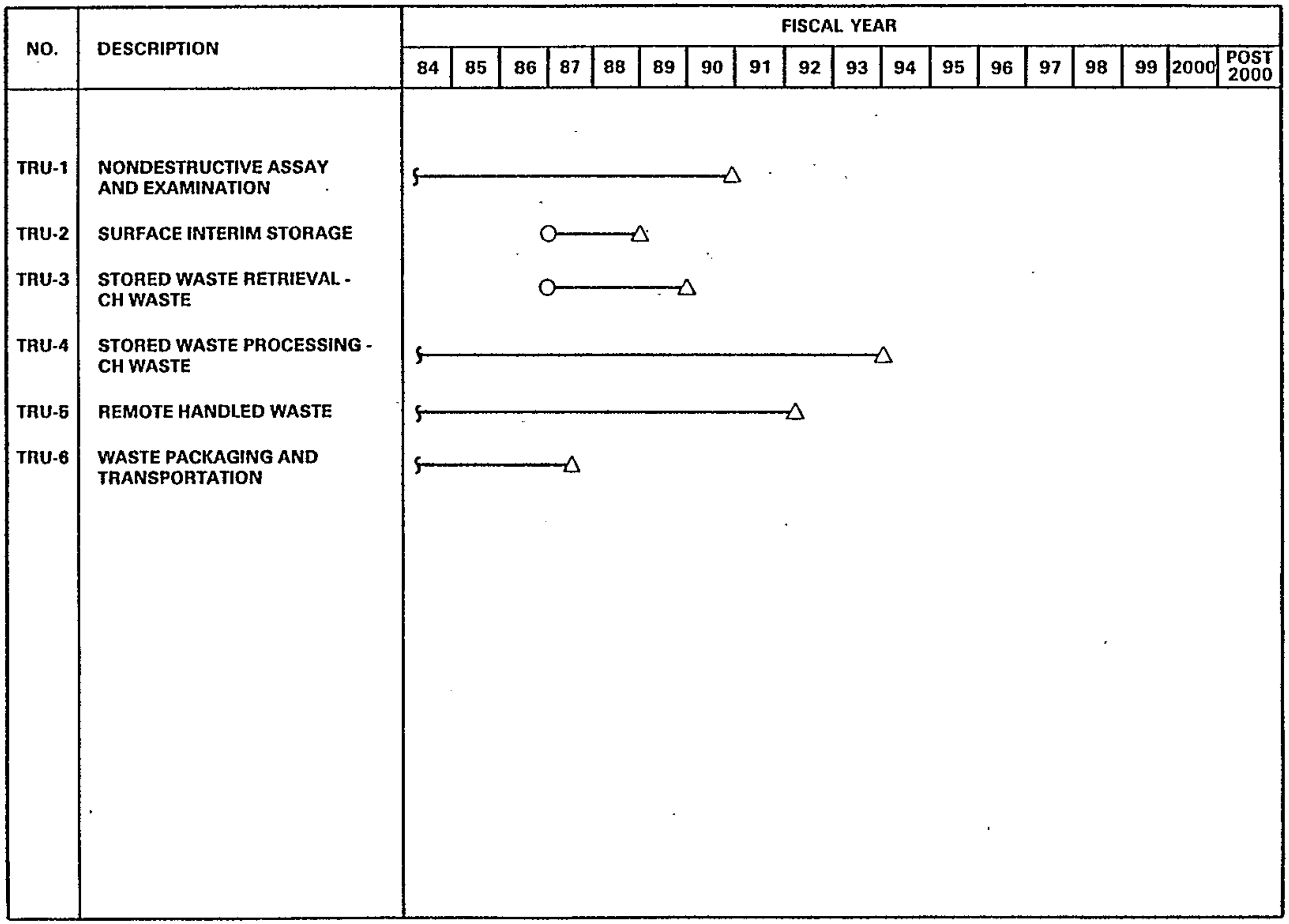

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FIGURE X-2. Schedules for Resolving TRU Technical Issues.

TABLE X-2. Estimated Technology Development Costs--
Stored and New Solid TRU Waste.

Technical issue		Estimated costs ($1,000)			
Identification symbol	Title	Manpower	Material	Capital equipment	Total
TRU-1	Assay and Nondestructive Examination	$ 3,220	$	$ 70	$ 3,290
TRU-2	Surface Interim Storage	300			300
TRU-3	Stored Waste Retrieval - CH Waste	325	75		400
TRU-4	Stored Waste Processing - CH Waste	16,500	1,100	1,500	19,100
TRU-5	Remote Handled Waste	14,900	400	190	15,500
TRU-6	Waste Packaging and Transportation	525			525
	TOTAL (rounded)	$35,800	$1,580	$1,760	$39,100

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Technical Issue TRU-1

ASSAY AND NONDESTRUCTIVE EXAMINATION

Statement of Issue

The technical issue is: What technology must be established to accomplish nondestructive analysis of closed drums of contact-handled (CH) TRU solid waste for TRU element content?

Suitable technology including procedures and equipment for routine assaying nondestructive examination (NDE) of closed drums of solid CH-TRU waste to determine contents and TRU element concentrations is not currently available at Hanford; presently, drums must be opened to determine their contents. Assay and NDE technology are needed, not only as part of an upgraded system for certifying drum contents and TRU element levels before shipment to the WIPP, but also to reduce inspection hazards and to avoid costs of storing rather than burying drums of non-TRU waste at Hanford.

Scope

Nondestructive assay/nondestructive examination (NDA/NDE) of TRU waste drums and boxes for determining compliance with the WIPP Waste Acceptance Criteria involves waste package weighing, assay, visual examination, fluoroscopic examination, waste record examination and, if needed, ultrasonic examination for corrosion defects. Suitable technology for NDA/NDE of drums and boxes needs to be developed.

Status

General - TRUSAF. A prototype NDA/NDE facility (TRUSAF) is planned for operation at Hanford in FY 1985. The TRUSAF will provide demonstrated retrievability and storage of CH-TRU, personnel training in NDA/NDE procedures, and the initial trial utilization of TRU assay and fluoroscopic examination systems. The TRUSAF will focus on CH-TRU waste drums only. The combination of NDA/NDE capabilities at TRUSAF will permit initial TRU segregation based on the 100 nCi/g definition.

General - WRAP. The TRUSAF will provide the basic proving ground for the NDA/NDE and the TRU waste capabilities to be included in the future WRAP facility. The WRAP facility will directly incorporate or modify the technologies proven at TRUSAF, expand to include NDA/NDE for CH-TRU waste boxes and provide for processing of noncertifiable TRU waste into a form certifiable for shipment to WIPP.

Waste Package Weighing. Available as part of TRUSAF. No development is necessary.

Assay. Considerable technology has been developed by Los Alamos National Laboratory (LANL) over the last several years for bulk TRU assay of closed solid waste drums. A system is being built for transfer to the Hanford Site and the TRUSAF. A box assayer system was developed and built by LANL and transferred to the Rocky Flats Site. Los Alamos National Laboratory is promoting the development of an assay system capable of assaying any arbitrarily sized container.

Radiography. The Idaho National Engineering Laboratory (INEL) has developed a realtime radiography (RTR) system as a NDE element in their plans for certification of solid TRU wastes. The system has a wide X-ray energy spectrum capability and is capable of examining boxes as well as waste drums.

Visual Examination. No development is required.

Waste Record Examination. Current record-keeping requirements include the required improved transfer record information details.

Ultrasonics. The INEL has developed a drum corrosion defect system employing ultrasonic detection.

Tasks to Close the Issue

The following tasks close the issue of NDA/NDE of CH-TRU solid wastes:

TRU-1.1 Complete engineering documentation for TRUSAF drum assay

Finalize plans and required engineering documentation for use of a TRU drum assay system at TRUSAF. This includes preparing Acceptance Test Procedures (ATP) and Operability Test Procedures (OTP) for the equipment and qualifying the equipment operators. ($210,000)

TRU-1.2 Complete engineering documentation for TRUSAF drum RTR

Finalize plans and required engineering documentation for use of a TRU drum RTR system at TRUSAF. This includes preparing ATP and OTP for the equipment and qualifying the system operators. ($130,000)

TRU-1.3 Develop alternative technology for NDA/NDE of CH-TRU waste

As necessary, develop alternative technology for NDA/NDE of CH-TRU solid wastes. ($300,000)

TRU-1.4 Develop criteria and procedures

Develop criteria and procedures for application of drum assay, drum RTR, visual observation, and record management of NDA/NDE methods at TRUSAF. ($80,000)

TRU-1.5 Conduct an engineering study for the ultrasonic testing of CH-TRU drums

Conduct an engineering study of the necessity for inclusion of ultrasonic testing as a routine NDE method for CH-TRU drums and provide a recommendation. ($50,000)

TRU-1.6 Conduct an engineering study and field demonstration of a box assaying system for WRAP

Conduct an engineering study of the CH-TRU waste box assaying system in use at the Rocky Flats Site for its application at the WRAP facility. Conduct a field demonstration of the LANL mobile assay system on Hanford box waste. ($265,000)

TRU-1.7 Conduct an engineering study of the RTR system for WRAP

Conduct an engineering study of RTR systems suitable for use at the WRAP facility for a wide range of container sizes and varying waste densities. The need for RTR capability to examine concrete and metal boxes, concrete-lined drums, and containers of building debris from decontamination and decommissioning activities should be included in the study. ($120,000)

TRU-1.8 Evaluate NDA/NDE TRUSAF methods for WRAP

Evaluate the NDE/NDA drum methods being developed at TRUSAF for applicability and limitations as a direct technology transfer to the WRAP facility. This should be an ongoing evaluation between TRUSAF development and operations and WRAP facility planning and design. ($60,000)

TRU-1.9 Develop alternative technology for NDA/NDE for WRAP

If necessary, develop alternative technology for NDA/NDE for CH-TRU wastes for the WRAP facility. ($1,400,000)

TRU-1.10 Develop technology for reduced waste generation

Develop technology to reduce the volume of newly generated solid TRU waste. Develop technology to reduce or eliminate the generation of noncertifiable TRU waste. ($600,000)

Flow Diagram

Figure X-3 illustrates the logical order of performing the tasks to close the nondestructive assay and examination technical issue.

Costs to Close the Issue

Manpower:	$3,220,000
Capital Equipment:	$70,000

Key Technical Decision

- TRU-1 (1): Is technology acceptable for NDA/NDE of CH-TRU wastes for the WRAP facility?

A "no" answer would eliminate the need to perform the following task:

- Develop alternative technology for NDA/NDE for WRAP. ($1,400,000)

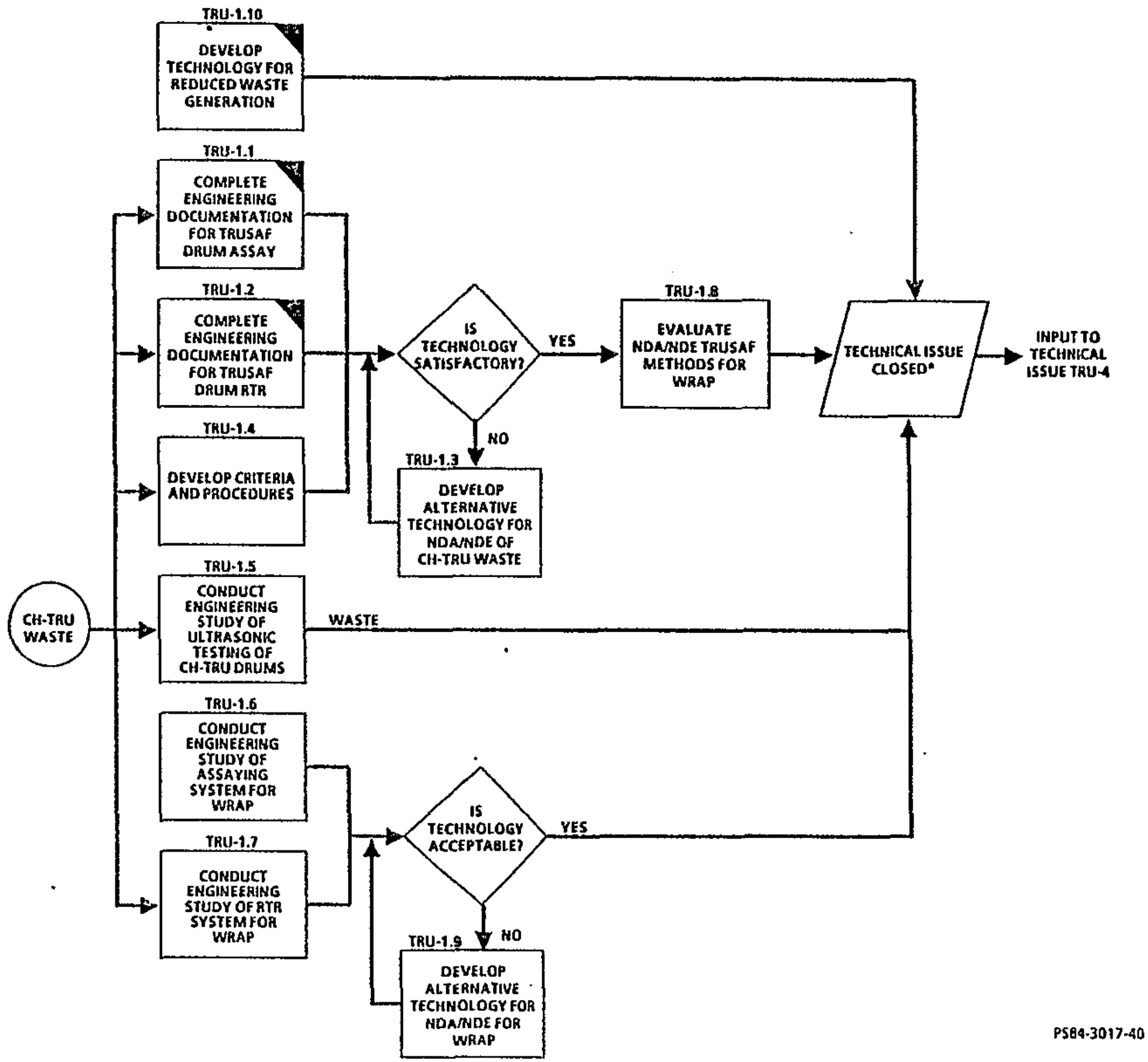

FIGURE X-3. Flow Diagram TRU-1--Nondestructive Assay and Examination.

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Technical Issue TRU-2

SURFACE INTERIM STORAGE

Statement of Issue

The technical issue is: What is the optimum design and configuration of facilities required for interim storage of containers of certified or certifiable CH-TRU solid waste?

Additional facilities (over and above those provided in the TRUSAF in the 224-T Building) are needed for aboveground interim storage of new certified/certifiable CH-TRU and RH-TRU solid waste containers. Other facilities are required to optimize use of the Transuranic Waste Package Transport (TRUPACT) System by mixing and matching CH low- and high-density containers and low- and high-curie-content containers. This technical issue is concerned with identifying, evaluating, and selecting the optimum surface interim storage facility complex.

Scope

To resolve this issue, different kinds and sizes of sheltered storage facilities must be identified and evaluated to meet projected solid waste storage needs and requirements. This evaluation will lead to a recommendation for type, size, and location for the storage facilities. A key part of facility evaluations includes consideration of acceptable drum/cask storage configurations and handling equipment.

Status

In a previous study, above ground storage alternatives for CH-TRU waste were examined. Assessment of the results of this study indicated that the types of facilities evaluated were too extensive and costly for the projected storage requirements.

Tasks to Close the Issue

The following tasks close the issue of surface interim storage of CH-TRU waste.

TRU-2.1 Recommend acceptable CH-TRU storage facility

Conduct a new engineering study to investigate and evaluate various strategies for acquisition of an acceptable storage facility and to make an appropriate recommendation. ($80,000)

TRU-2.2 <u>Prepare FDC, CDR, and Safety Analysis Report (SAR) for a CH-TRU facility</u>

Perform required work to prepare FDC, CDR, and SAR documents for the recommended certified/certifiable CH-TRU waste storage facility. ($220,000)

Flow Diagram

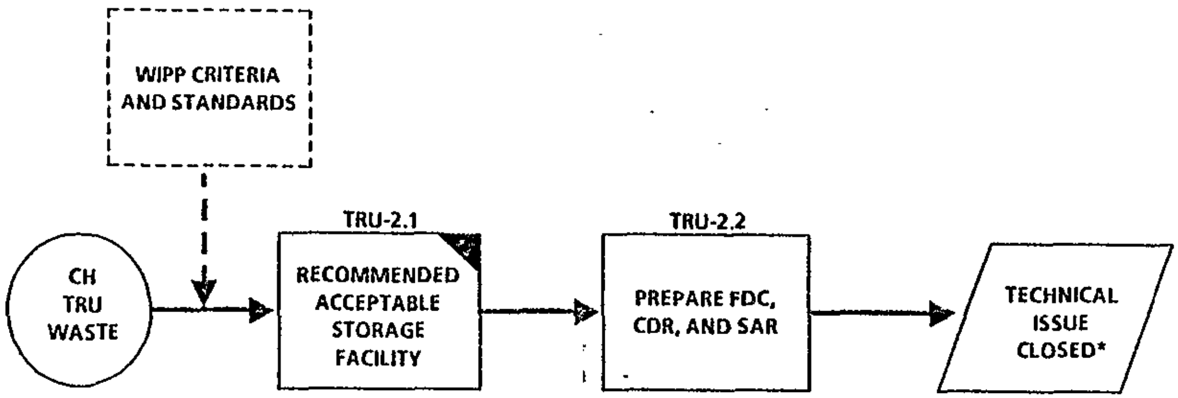
Figure X-4 illustrates the order of performing the tasks required to close the Surface Interim Storage issue.

Cost to Close the Issue

Manpower: $300,000

Key Technical Decisions

No key technical decisions were identified as being required to assure adequate facilities for surface interim storage of CH-TRU wastes.



*ADEQUATE FACILITIES FOR SURFACE INTERIM STORAGE OF CH-TRU WASTE ARE DESIGNED OR PROCURED.

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FIGURE X-4. Flow Diagram TRU-2--Surface Interim Storage.

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Technical Issue TRU-3

STORED WASTE RETRIEVAL - CONTACT HANDLED WASTE

Statement of Issue

The technical issue is: What equipment, facilities, and procedures need to be designed and/or prepared so that containers of CH-TRU waste stored at the Hanford Site can be safely retrieved and transported to the WRAP facility?

Scope

Contact-handled TRU waste is generally stored on asphalt pads and covered with 4 ft of soil. Plastic sheeting is placed over the waste before it is covered with soil. The resulting module is designed to simplify retrieval operations. The condition of the storage module and containers after a specific storage time determines the complexity of retrieval operations. Thus, results of retrieval tests will contribute greatly to decisions about the nature of a full-scale retrieval facility and its equipment.

The currently proposed concept for minimum handling of CH-TRU solid waste includes:

- Providing appropriate earth moving and transporting equipment. Manual earth moving will be performed as required to eliminate the possibility of damaging storage modules with heavy equipment.
- Providing remotely operated over-packing machines to handle bulged or ruptured containers.
- Providing forklift trucks to load retrieved containers for transport to the WRAP Facility.

Status

A corner of a 10-yr-old stored CH-TRU module was unearthed in 1982 to evaluate the integrity of the storage containers and to provide data from which to estimate the adequacy of module configurations for 20-yr retrievable storage. Visual inspection and ultrasonic thickness measurements of containers indicated negligible corrosion. (As part of the examination of this drum, a follow-on inspection in 1987 or 1988 was recommended to determine if corrosion has accelerated beyond acceptable limits.)

Tasks to Close the Issue

The following tasks close the issue of retrieval of stored CH-TRU wastes:

TRU-3.1 Perform CH-TRU waste retrieval tests

Plan, conduct, and evaluate results of CH-TRU waste retrieval tests. ($150,000)

TRU-3.2 Recommend retrieval technology/facility

Perform an engineering study to recommend retrieval procedures, equipment and a retrieval facility if needed. ($150,000)

TRU-3.3 Prepare FDC, SAR, and CDR for CH-TRU retrieval facility

Prepare, if necessary, FDC, SAR, and CDR for CH-TRU waste retrieval facilities. ($25,000)

Flow Diagram

Figure X-5 illustrates the logical order of performing the tasks to close the issue of retrieval of stored CH and RH wastes.

Costs to Close the Issue

Manpower: $325,000
Materials: $75,000

Key Technical Decision

- TRU-3 (1): Is a special CH-TRU retrieval facility required?

A "no" answer would eliminate the need to perform the following tasks:

Prepare FDC, SAR, and CDR, for retrieval facility. ($25,000)

In addition, design and construction of a retrieval facility for CH-TRU solid wastes would not be required.

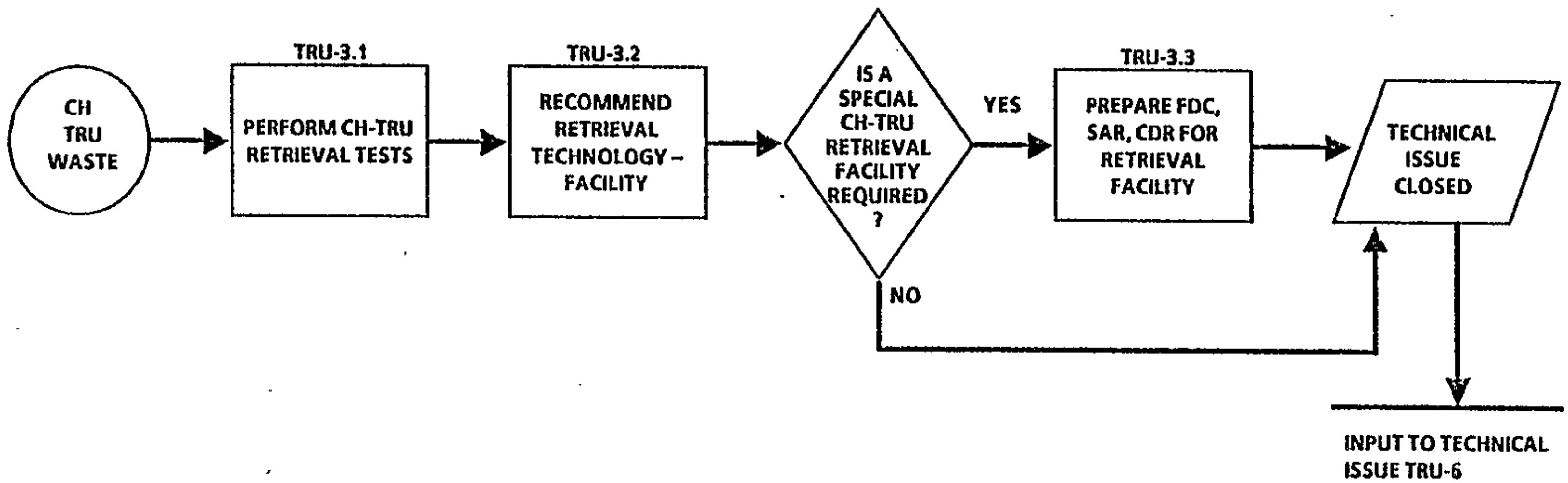

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FIGURE X-5. Flow Diagram TRU-3--Stored Waste Retrieval - Contact Handled Waste.

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Technical Issue TRU-4

STORED WASTE PROCESSING - CH WASTE

Statement of Issue

The technical issue is: What technology is required to be able to process and repackage retrieved CH-TRU wastes stored at the Hanford Site prior to shipment of such wastes to the WIPP?

Prior to shipment to the WIPP for final disposal, stored CH-TRU wastes at the Hanford Site must be examined, processed, and repackaged. This particular technical issue is a broad-based one relating to all facets of the technology involved in design of the CH-WRAP facility and in feasible ways of processing retrieved CH-TRU waste to reduce its volume and prepare it for shipment to WIPP.

Scope

A CH-WRAP facility will be developed to provide the capabilities required to certify stored CH-TRU wastes for WIPP disposal. Identified capabilities include drummed waste processing and oversized boxed waste size reduction. Drum waste assaying and nondestructive examination capabilities previously discussed are to be provided on an interim basis in the TRUSAF facility (Technical Issue TRU-1) and must also be incorporated into the WRAP facility.

Status

An engineering study of the CH-WRAP facility has been completed and provides preliminary recommendations on both drum processing and box size reduction technology. The preferred approach for drum processing involves a shred and grout immobilization process for drum waste which cannot otherwise be certified. Size reduction includes various cutting technology to reduce oversize boxes to an acceptable size for processing and packaging.

Tasks to Close the Issue

The following tasks close the issue of processing stored CH-TRU wastes:

TRU-4.1 Update CH-WRAP engineering study

Update and reissue CH-WRAP facility engineering study incorporating feasibility test data. The study should compare the shred/grout process to the INEL shred/incineration/grout process for CH-TRU waste immobilization. ($53,000)

TRU-4.2 Shred/grout processing

Develop shred/grout formulations and product tests in compliance with the WIPP-WAC. Evaluate existing technologies at other DOE sites for incorporation/modification into CH-WRAP design. ($1,600,000)

TRU-4.3 Product certification to WIPP-WAC

Conduct testing independent of the process development laboratory for immobilized products produced from shred/grout processing, liquid organic processing, and special processing, and determine compliance with the WIPP-WAC. ($685,000)

TRU-4.4 Systems safety assessments

Evaluate the characteristics of stored CH-TRU waste containers for dose rates, hydrogen buildup, quantities and type of fissile materials, and other hazardous materials. Perform criticality, health physics, and hazardous materials handling/safety studies to support design criteria for WRAP. ($560,000)

TRU-4.5 Develop size reduction equipment

Develop and test large box size reduction equipment. Evaluate large box size reduction experience and technologies at other DOE sites. Survey treatment options, select methods and equipment. ($900,000)

TRU-4.6 Assess process/materials handling techniques

Study and assess automated techniques for process/materials handling at CH-WRAP facility. Select options for incorporation into WRAP. Determine the optimum practical size waste box to handle and transport through WRAP. ($230,000)

TRU-4.7 Identify and recommend special processing equipment

Analyze the need for special laboratory processing capabilities at WRAP; recommend necessary equipment. ($200,000)

TRU-4.8 Select liquid organic processing technique

Evaluate and identify liquid organic processing techniques compatible with the WIPP-WAC for incorporation into WRAP. Select the optimum liquid organic processing option. ($185,000)

TRU-4.9 Select pressure detection/gas venting method

Evaluate stored CH-TRU waste at Hanford for gas generation and pressurization characteristics. Evaluate INEL and other DOE sites' experiences with pressurized waste containers. Survey options. Select the optimum detection/treatment method. ($155,000)

TRU-4.10 Develop WIPP certification plans for stored TRU wastes

Develop plans for WIPP certification of TRU waste retrievably stored since 1970 and examined/processed/packaged in CH-WRAP facility. ($180,000)

TRU-4.11 Examine alternative processes to shred/grout

Evaluate alternatives to shred/grout processing such as compaction and encapsulation. Evaluate final waste form for integrity and compliance with WIPP-WAC. Assess development required to establish process parameters and prove equipment. ($245,000)

TRU-4.12 Conduct pilot-scale testing

Conduct pilot-scale equipment testing and product analysis studies in support of process system integration for the CH-WRAP facility. ($1,700,000)

TRU-4.13 Prepare SAR and EA

Prepare safety analysis reports and environmental documentation for CH-WRAP. ($620,000)

TRU-4.14 Prepare FDC and CDR

Update and finalize CH-WRAP FDC and prepare CH-WRAP CDR. ($1,060,000)

TRU-4.15 Operations support

Provide operational support including readiness review, work procedures, and training. ($2,200,000)

TRU-4.16 Cold test operations

Perform appropriate prestartup tests. Modify equipment and facility as needed. ($5,900,000)

Flow Diagram

Figure X-6 illustrates the logical order of performing the tasks required to close the issue of processing stored CH-TRU waste.

Costs to Close the Issue

Manpower:	$16,500,000
Materials:	$1,100,000
Capital Equipment:	$1,500,000

NOTE: Part of the costs for development of technology for the WRAP Facility are also included in Technical Issues TRU-1, -2, and -3.

Key Technical Decision

- TRU-4 (1): Is the shred/grout process feasible and acceptable?

A "no" answer would eliminate the need to examine alternative processes to shred/grout. ($245,000)

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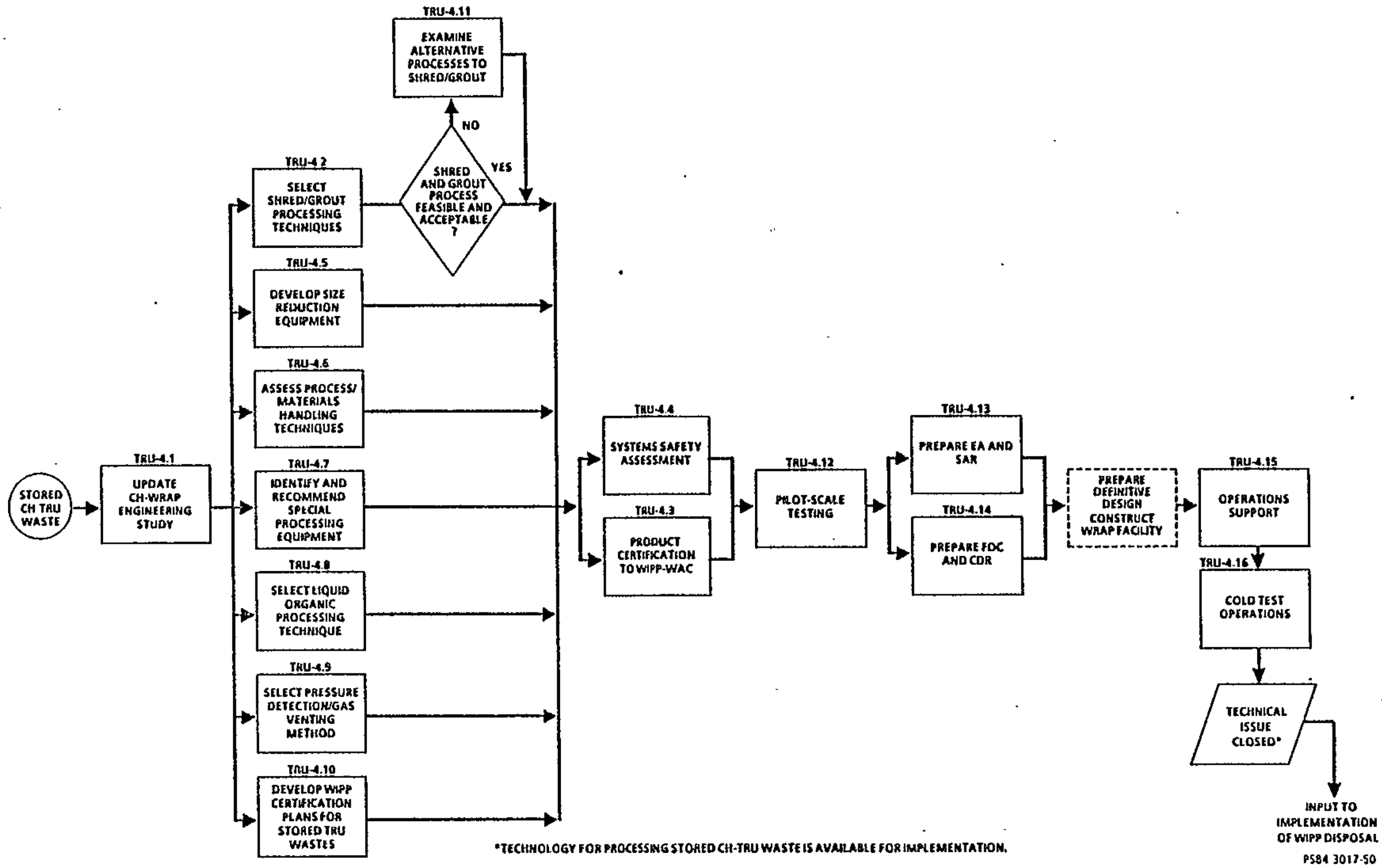

FIGURE X-6. Flow Diagram TRU-4--Stored Waste Processing - Contact-Handled Waste.

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Technical Issue TRU-5

REMOTE-HANDLED WASTE

Statement of Issue

The technical issue is: What is the optimum strategy for disposing of remote-handled TRU solid waste currently stored in caissons and what technology needs to be developed and tested to implement such strategy?

Remote-handled (RH) TRU waste generated at the Hanford Site since 1970 has been stored in subsurface caissons. This technical issue relates to the need and the procedures to define a strategy for retrieval, treatment, and disposal of the Hanford RH-TRU.

Scope

Since 1970, RH-TRU waste generated at the Hanford Site has been stored in subsurface caissons. The reference waste management strategy for this waste and new RH waste consists of retrieval, processing, and geologic repository disposal. Repository disposal will require the development of waste retrieval and processing technology. The plan for pre-1970 RH-TRU waste is onsite stabilization and isolation which requires the development of void fill and engineered barrier systems.

The scope of this issue assumes that a facility for processing RH-TRU waste will be designed for handling oversized items that technically meet the definition RH-TRU waste, but administratively have not been designated as "waste" (i.e., currently included in D&D waste inventories).

Status

Current plans project two waste facilities for stored RH-TRU wastes. An RH-TRU waste retrieval facility is planned for the retrieval of waste stored in the 200 Area alpha caissons. A Remote-Handled Waste Receiving and Packaging (RH-WRAP) facility is planned for the processing of retrieved caisson waste. The RH-WRAP may also be used to process and certify newly generated RH-TRU waste. Requirements for this facility have not been extensively studied. A preferred alternative would be to modify an existing facility to serve as the RH-WRAP facility. However, until that can be shown to be feasible, this plan will be based on a new facility. The biggest uncertainty estimating the size and cost of the RH-WRAP facility is the lack of identification of the subject waste. If the RH-WRAP was expected to be able to handle the large process vessels from PUREX, for example, the facility would have to include a PUREX canyon-sized receiving area and canyon-sized operating cells, along with large size reduction capabilities. The extensive technology requirements proposed herein are based upon such a facility. Restricting the waste feed to Hanford's hot cell waste would significantly reduce the technology requirements and costs.

An RH-TRU Interim Storage Study was completed in FY 1984. Existing facility space was used to examine storage alternatives for RH-TRU waste; an assessment of this study indicated that this type of storage would be too extensive and costly. Outside, underground storage was proposed. An underground storage facility that provides dry storage and easy access to the RH-TRU waste packages will be designed. The options proposed are: 1) poured concrete cells or steel caissons with waterproof coverblocks, or 2) directly buried concrete caissons designed for reasonably simple field retrieval.

Tasks to Close the Issue

The following tasks close the issue of certification for RH-TRU waste:

TRU-5.1 Prepare and issue RH-TRU certification plan

Develop and issue a plan for meeting WIPP certification requirements for newly generated and stored RH-TRU. ($50,000)

TRU-5.2 Develop strategy for handling RH-TRU waste

Conduct a study to define the strategy for handling and disposing of currently stored caisson and newly generated RH wastes. ($300,000)

TRU-5.3 Develop transloading technology

Develop methods and procedures for loading primary containers of newly generated RH-TRU waste into 30-gallon interim storage containers. Demonstrate the methodology. This technology is needed for contamination control and for simplification of storage and retrieval. ($100,000)

TRU-5.4 Conduct TRU caisson retrieval system study

Conduct an engineering study to recommend a suitable facility for retrieval of RH-TRU waste from caissons, including identification of facility and equipment requirements. ($250,000)

TRU-5.5 Develop TRU caisson retrieval technology

Conduct appropriate engineering studies and tests of equipment and procedures which can be used to safely retrieve RH-TRU waste from caissons. Following the proof of feasibility of retrieval, design and verify special equipment required for canister retrieval. ($1,200,000)

TRU-5.6 Prepare FDC and CDR for RH-TRU retrieval facility

If necessary, prepare FDC and CDR for RH-TRU waste retrieval facility. ($220,000)

TRU-5.7 Evaluate use of CH-TRU NDA/NDE methods for RH-TRU wastes

Conduct an engineering study to evaluate the applicability and the limitations of CH-TRU developed NDA/NDE methods for their use in the handling of RH-TRU solid wastes. ($60,000)

TRU-5.8 Develop alternative technology for NDA/NDE of RH-TRU wastes

If necessary, develop alternative technology for NDA/NDE of RH-TRU solid wastes. ($2,500,000)

TRU-5.9 Conduct study of interim storage of RH-TRU (Completed)

Perform engineering studies to determine a suitable configuration for a facility for interim storage of RH-TRU waste prior to shipment to the WIPP. (Completed in FY 1984)

TRU-5.10 Design facility for interim storage of RH-TRU

Evaluate design of ORNL RH-TRU storage facility for compatibility with Hanford needs. Design a facility for interim underground storage of RH canisters/containers. Construct and test prototype facility. ($265,000)

TRU-5.11 Evaluate existing facilities for processing/packaging RH-TRU waste

Complete a study to evaluate the suitability of existing facilities for processing and packaging of retrieved caisson waste and new RH-TRU waste. ($240,000)

TRU-5.12 Define facility modifications

Define the requirement for modification of an existing facility for processing RH-TRU waste. Modify design as required. Complete appropriate environmental documentation. ($1,500,000)

TRU-5.13 Conduct RH-WRAP facility study

Conduct an engineering study to define requirements of the currently planned RH-WRAP facility. This study will address both newly generated and stored wastes based on the previously defined strategy. Alternatives will include a centrally located facility and multiple generator specific facilities. ($400,000)

TRU-5.14 <u>Prepare FDC, CDR, and SAR for RH-WRAP</u>

Prepare conceptual design, safety analysis reports, and environmental documentation for RH-WRAP. ($2,800,000)

TRU-5.15 <u>Develop required size and volume reduction technology</u>

Conduct appropriate engineering studies and tests to develop size and volume reduction technology required to process oversized retrieved RH-TRU wastes to a form suitable for shipment, with or without immobilization in grout, to the WIPP. ($3,000,000)

TRU-5.16 <u>Develop technology for processing RH-TRU waste</u>

Conduct laboratory and pilot-scale studies to develop and demonstrate suitable technology for processing (e.g., shred/grout, plasma pyrolysis) of RH-TRU waste to conform to WIPP/WAC. ($2,000,000)

<u>Flow Diagram</u>

Figure X-7 illustrates the logical order for completion of tasks required to close the issue of RH-TRU waste.

<u>Costs to Close the Issue</u>

Manpower:	$14,900,000
Materials:	$400,000
Capital Equipment:	$190,000

<u>Key Technical Decisions</u>

- TRU-5 (1): Is a special RH-TRU retrieval facility required?
- TRU-5 (2): Is an existing facility (with modifications) suitable for processing/packaging of RH-TRU waste?
- TRU-5 (3): Is development of size reduction technology required for RH-TRU waste?

A "no" answer to TRU-5 (1) would eliminate the need to perform the following tasks.

- Develop TRU caisson retrieval technology. ($1,200,000)
- Prepare FDC, CDR for RH-TRU retrieval facility. ($220,000)*

*In addition, design and construction of a retrieval facility would not be required.

A "yes" answer to TRU-5 (2) would eliminate the need to perform the following tasks.

- Conduct RH-WRAP facility study. ($400,000)

- Prepare FDC, CDR, and SAR for RH-WRAP. ($2,800,000)

A "no" answer to TRU-5 (3) would eliminate the need to develop required size and volume reduction technology. ($3,000,000)

Favorable answers to all three key technical decisions would result in a maximum cost savings of $7,620,000.

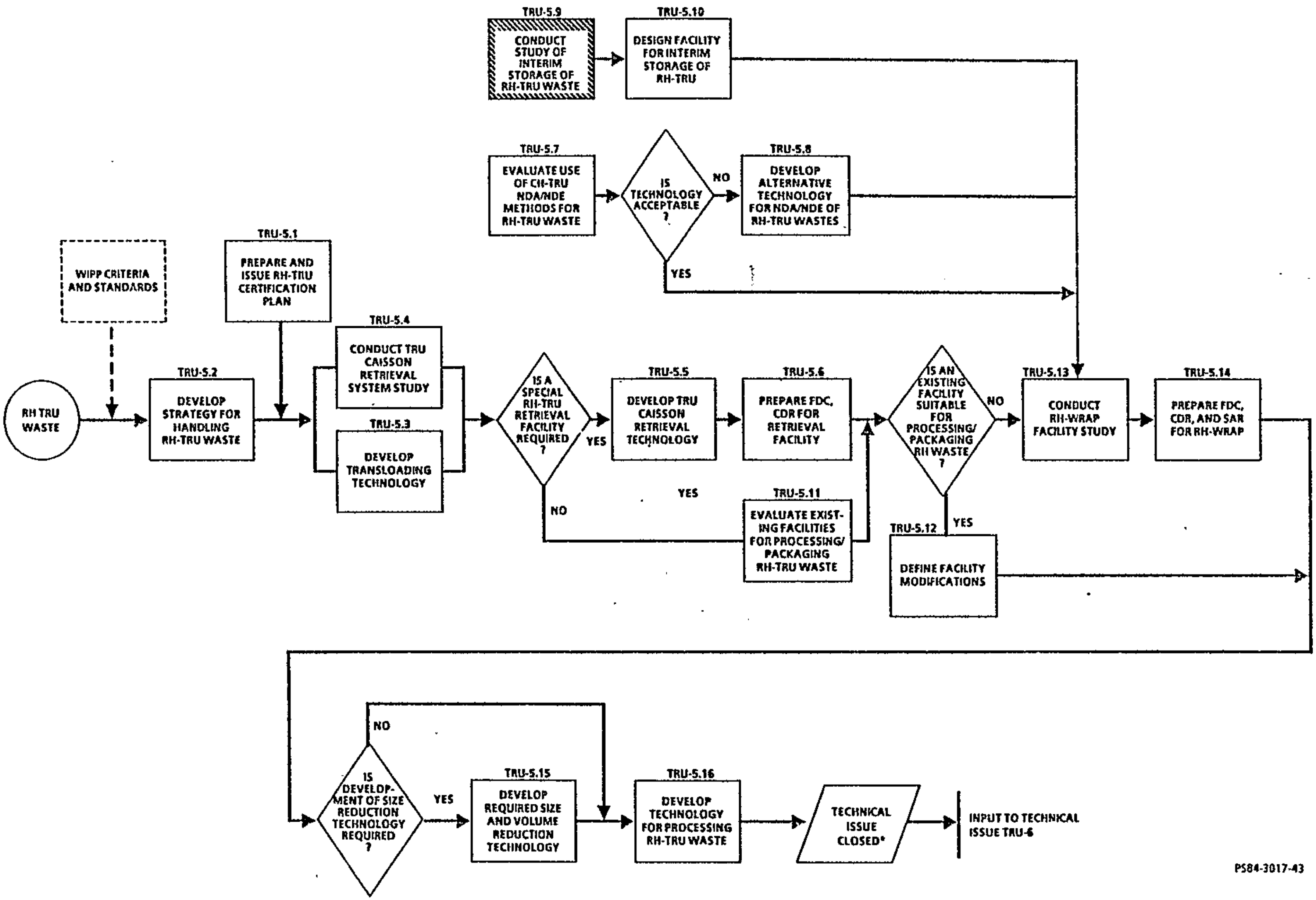


FIGURE X-7. Flow Diagram TRU-5--Remote-Handled Waste.

Technical Issue TRU-6

WASTE PACKAGING AND TRANSPORTATION

Statement of Issue

The technical issue is: What technical tasks must be completed to ensure that containers for RH- and CH-TRU waste are compatible with the transportation system being designed for shipment of the waste to WIPP?

Common waste packaging and transportation systems must be developed to accommodate both CH- and RH-TRU wastes from various generators of such wastes in the U.S. Rockwell is committed to design and qualify the RH-TRU container which must be compatible with planned WIPP receiving and handling facilities. This technical issue relates to the tasks which must be completed for Rockwell to meet its commitment.

Scope

Common packaging and transportation systems are planned for use by all TRU waste generators for both CH and RH waste. The TRUPAC shipping container is being developed to transport a variety of CH-TRU wastes. The RH waste system includes a unique RH-TRU container and shipping cask. Rockwell is responsible for design and qualification of the RH-TRU container. The TRUPAC and RH container shipping cask development are being coordinated by the Sandia National Laboratory.

Status

The prototype RH-TRU container has been fabricated and qualification tests will were performed in FY 1984. The container design is similar in outside dimensions to the Savannah River Defense High Level Waste (DHLW) container for which a shipping cask has already been built. Minor, but costly modifications to the DHLW shipping cask are required to allow its use as the shipping cask for the RH-TRU waste container; any such modifications would be performed by or through Sandia National Laboratory. A prototype RH-TRU closure welding system was designed and fabricated in FY 1984.

Tasks to Close Issue

The following tasks close the issue of waste packaging and transportation of CH- and RH-TRU wastes:

TRU-6.1 <u>Fabricate prototype RH-TRU container</u> (Completed)

Fabricate a prototype RH-TRU container for use in qualification testing. (Completed in FY 1984)

TRU-6.2 Demonstrate RH-TRU closure welding system

Demonstrate the prototype RH-TRU container closure welding system. ($145,000)

TRU-6.3 Inventory work off plan

Reevaluate and revise the TRU waste inventory work off plan. ($100,000)

TRU-6.4 Qualify CH-TRU container

Review, revise, and requalify the CH-TRU container as required to ensure that containers can be shipped and to insure that the certification criteria are met. ($100,000)

TRU-6.5 Interface working groups (IWG)

A series of IWGs has been organized to assist in managing interface between the transuranic Waste Lead Organization and the WIPP Project Office. Specific concerns of technology, hardware development, and hardware modification will be addressed by the IWGs. ($180,000)

Flow Diagram

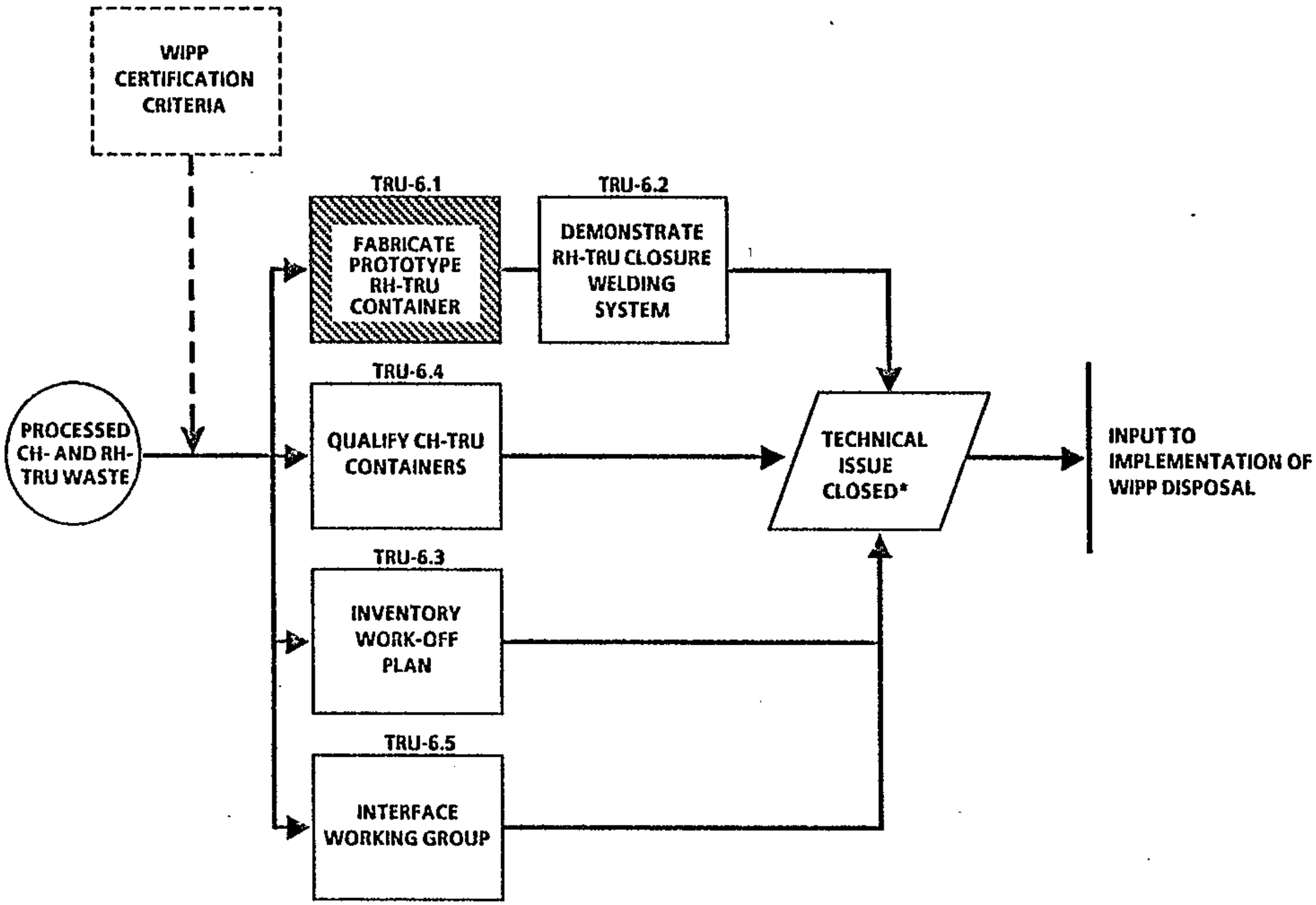
Figure X-8 illustrates the logical order of performing the tasks required to close the waste packaging and transportation issue.

Costs to Close the Issue

Manpower: $525,000

Key Technical Decisions

No key technical decisions were identified as being required to qualify the CH- and RH-TRU containers for compatibility with WIPP receiving and handling facilities.



*CONTAINERS COMPATIBLE WITH TRANSPORTATION SYSTEM BEING DESIGNED FOR SHIPMENT OF WASTE TO WIPP.

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FIGURE X-8. Flow Diagram TRU-6--Waste Packaging and Transportation.

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XI. MISCELLANEOUS WASTES

A. REFERENCE DISPOSAL PLAN

The reference plan for disposal of miscellaneous wastes is shown in Figure XI-1.

B. SCHEDULE

Schedules for resolving the miscellaneous waste technical issues are shown in Figure XI-2.

C. COST SUMMARY

Table XI-1 summarizes the costs associated with development of technology required to close the miscellaneous waste issues.

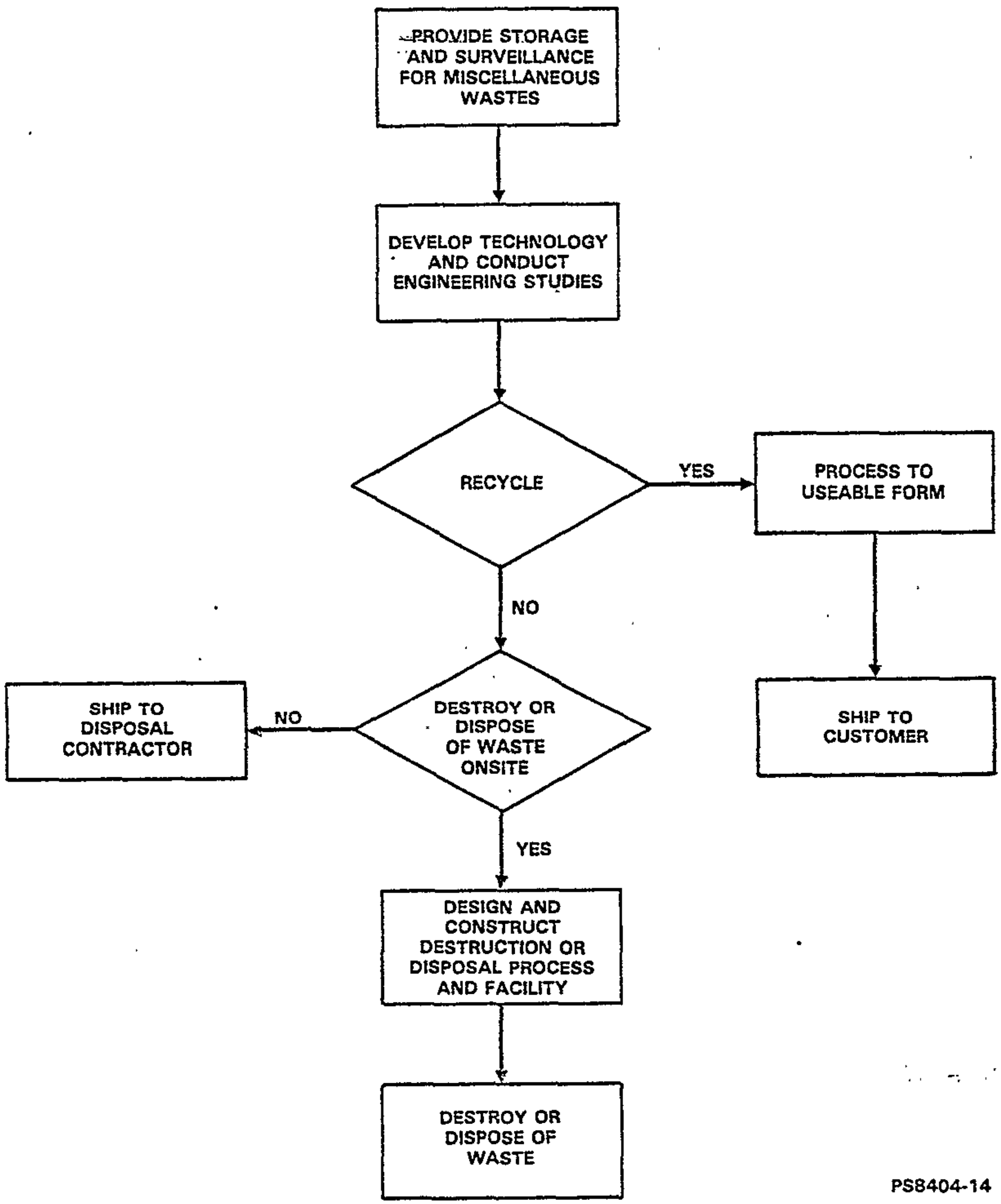

FIGURE XI-1. Reference Plan for the Management of Miscellaneous Waste.

9 1 1 2 3 5 4 0 2 ? 0

NO.	DESCRIPTION	FISCAL YEAR 84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	POST 2000
MSC-1	LIQUID ORGANIC WASTE*																		
MSC-2	CONTAMINATED SODIUM METAL*																		

*SEE FOOTNOTE f, TABLE 3-1, PG. III-3.

IF ADEQUATE FUNDING BECOMES AVAILABLE, CLOSURE OF THESE ISSUES MAY BE EARLIER THAN FY 1984.

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FIGURE XI-2. Schedules for Resolving MSC Technical Issues.

TABLE XI-1. Estimated Technology Development Costs--
Miscellaneous Wastes.

Technical issue		Estimated costs ($1,000)			
Identification symbol	Title	Manpower	Material	Capital equipment	Total
MSC-1	Liquid Organic Waste	$1,540	$250	$400	$2,190
MSC-2	Contaminated Sodium Metal	70			70
	TOTAL	$1,610	$250	$400	$2,260

Technical Issue MSC-1

LIQUID ORGANIC WASTES

Statement of Issue

The technical issue is: What technology, if any, must be developed to permit continued safe storage and eventual disposal of the large inventory of radioactively contaminated organic liquids (mixed hazardous wastes) currently stored at the Hanford Site?

A large (approximately 380,000 L) inventory of various organic liquids contaminated with small amounts and types of radionuclides has accumulated at the Hanford Site as the result of past chemical processing operations. Future operation of the PUREX and PFP plants will add to this inventory. Limits acceptable for environmental disposal of mixed hazardous wastes will be based on current as well as future federal and state legislation governing the management of these materials at DOE hazardous waste disposal sites. The issue considered here is the technology required to help decide upon a cost-effective schedule and program for an orderly and environmentally acceptable method for disposal of present and future liquid organic wastes.

Scope

The bulk of the currently stored inventory of contaminated organic waste liquids consists of a mixture of normal parrafin hydrocarbons containing various amounts of tri-*n*-butyl phosphate (TBP) and *bis*(2-ethylhexyl) phosphoric acid and their degradation products. Small amounts of methyl isobutyl ketone, vacuum pump oil, lubrication oil, hydraulic fluids, and mixtures of TBP and carbon tetrachloride also exist. If the TRUEX process was implemented spent TRUEX process solvent would accumulate and must also be disposed of. Disposition of these diverse organic waste solutions remains an unresolved issue.

Status

Studies of technology for use in disposing of the inventory of stored wastes have been conducted periodically for over 15 years. Many of these studies have concluded that incineration procedures (e.g., plasma-arc, thermomagnetic, etc.) are suitable for combustion of the spent solvents. While these procedures are suitable for combustion of organic wastes, they may not be 100% efficient or cost-effective. Microbial degradation processes are now being considered as alternatives for the treatment of organic wastes. A document has been prepared which evaluates for site managers the use of this process as an alternative in hazardous waste cleanup and control (Becker and Rogers, 1983). Engineering studies have been performed to assess the technical and economic feasibility of shipping the Hanford inventory of contaminated methyl isobutyl ketone to the DOE Idaho Site for either beneficial use or disposal.

Tasks to Close the Issue

The following tasks close the issue of liquid organic wastes:

MSC-1.1 Conduct a literature review

Identify and evaluate the key federal and state legislative guidelines for the environmental disposal of organic wastes. Identify limits for constituents of organic wastes stored at Hanford and regulated by current federal and state legislation. Make recommendations for storage and disposal for nonregulated organic constituents that may come under future legislative action. ($75,000)

MSC-1.2 Characterize and classify organic wastes

Based on chemical composition and current regulatory guidelines, separate the organic waste liquids into categories potentially requiring different disposal technology. ($320,000)

MSC-1.3 Evaluate and recommend candidate organic waste degradation methods

Perform an engineering study to evaluate and recommend candidate organic degradation methods and equipment. Review and summarize results and recommendations of previous studies. Determine from appropriate cost and risk analyses and from environmental impact standpoints when disposal of liquid organic wastes can and should be completed. Develop schedules for further technology development, if needed, and for orderly work off of the inventory. ($140,000)

MSC-1.4 Develop and demonstrate organic degradation and/or disposal methods

Develop, test, and demonstrate degradation disposal methods for all defined categories of liquid organic wastes. ($1,000,000)

Flow Diagram

Figure XI-3 illustrates the logical order of performing the tasks required to close the liquid organic wastes technical issue.

Costs to Close the Issue

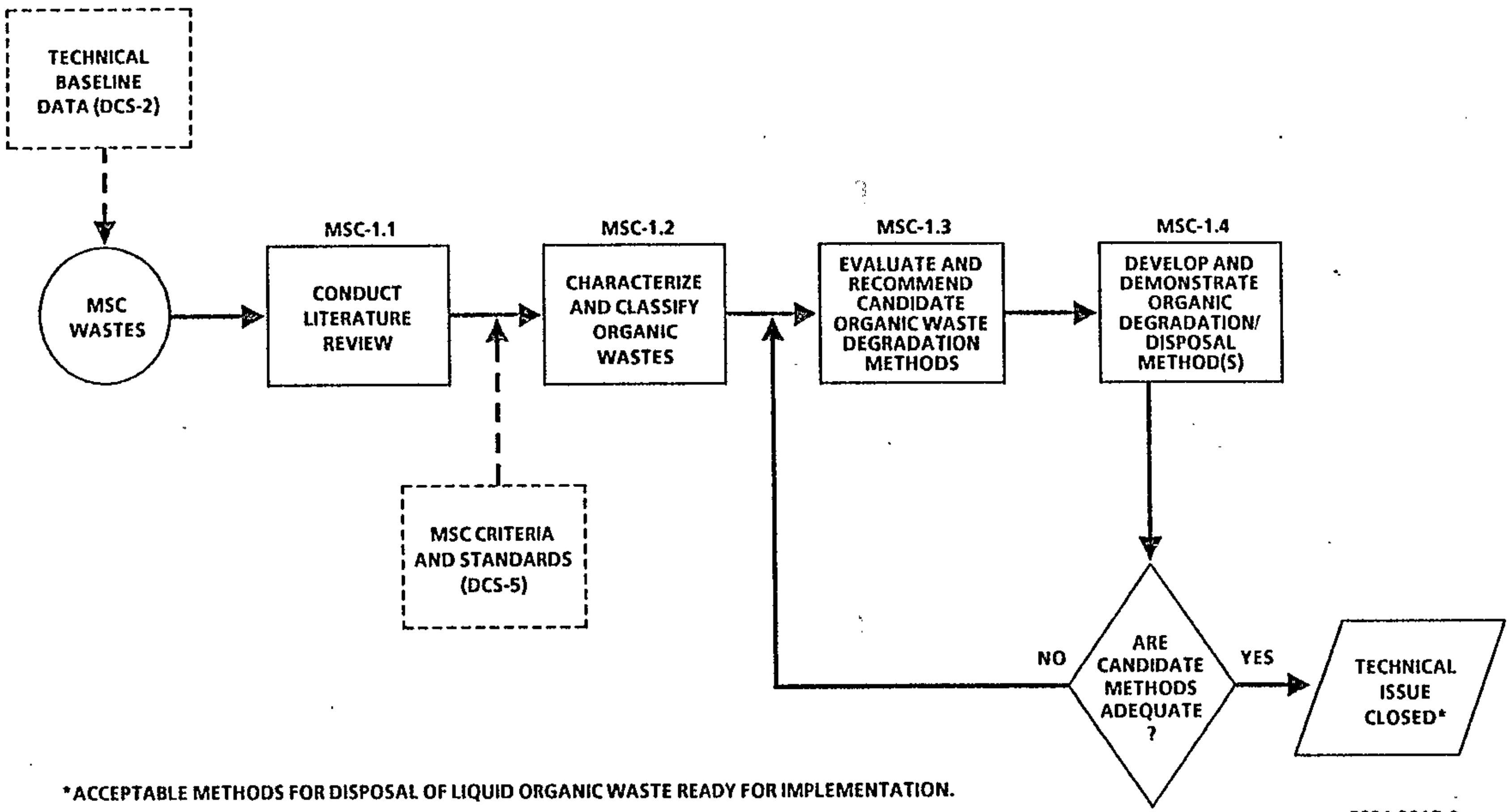
Manpower:	$1,540,000
Materials:	$250,000
Capital Equipment:	$400,000

Key Technical Decisions

No key technical decisions have been identified as being required to safely dispose of liquid organic wastes.

Bibliography

Becker, C. D. and J. E. Rogers (1983), EPA Guide for Identifying Cleanup Alternatives at Hazardous Waste Sites and Spills: Biological Treatment, PNL-4601 (EPA-600/3-83-063), Battelle, Pacific Northwest Laboratories, Richland, Washington.



*ACCEPTABLE METHODS FOR DISPOSAL OF LIQUID ORGANIC WASTE READY FOR IMPLEMENTATION.

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FIGURE XI-3. Flow Diagram MSC-1--Liquid Organic Wastes.

Technical Issue MSC-2

CONTAMINATED SODIUM METAL

Statement of Issue

The technical issue is: What, if any, technology must be developed to permit continued safe storage, reuse or disposal of the approximately 280 tons of radioactively-contaminated sodium metal currently stored at the Hanford Site?

Scope

Contaminated sodium metal has been stored in the 2727-W and 2727-WA buildings at the Hanford Site since 1967; the latest addition to the inventory was made in 1976. Currently, management of this material focuses on safe storage pending reuse in some part of the breeder reactor development program. Tasks identified here relate primarily to continued safe storage of the sodium and to identifying users; the scope also includes upgraded analyses of disposal options and processes.

Status

A sodium waste management plan was prepared in 1981 to identify and evaluate alternatives to continued long term storage of sodium metal at Hanford. This study recommended reuse of the material as the least costly and preferred alternative. Recently, 150 tons of sodium were transferred to Fast Flux Test Facility for use in the Fuel Storage Facility. Current plans call for the 130 tons of sodium stored in 55-gallon drums to be overpacked for storage if a user is not found in the next several years.

In FY 1985, a scoping study was performed to recommend methods for disposition of contaminated sodium metal. It was recommended that the metal be converted to sodium hydroxide (NaOH) using a method developed at the Idaho National Engineering Laboratory for disposal of cooling sodium from the Experimental Breeder Reactor. It was suggested that the NaOH could be utilized in the PUREX process for neutralization of acidic waste solutions.

Tasks to Close the Issue

The following tasks close the issue of contaminated sodium metal waste:

MSC-2.1 Compile user data

Conduct periodic surveys to identify and contact users of contaminated sodium. ($35,000)

MSC-2.2 Determine drum overpack requirements.

Conduct an engineering study to determine needs and timing for overpacking drums of metal (to enhance storage safety) and to recommend overpacking material and procedures. ($35,000)

MSC-2.3 Recommend waste disposition (Completed)

Update a previous engineering study to recommend a proposed procedure for final disposal, if and when required; list required technology development needs to implement final disposal option. (Completed in FY 1985)

Flow Diagram

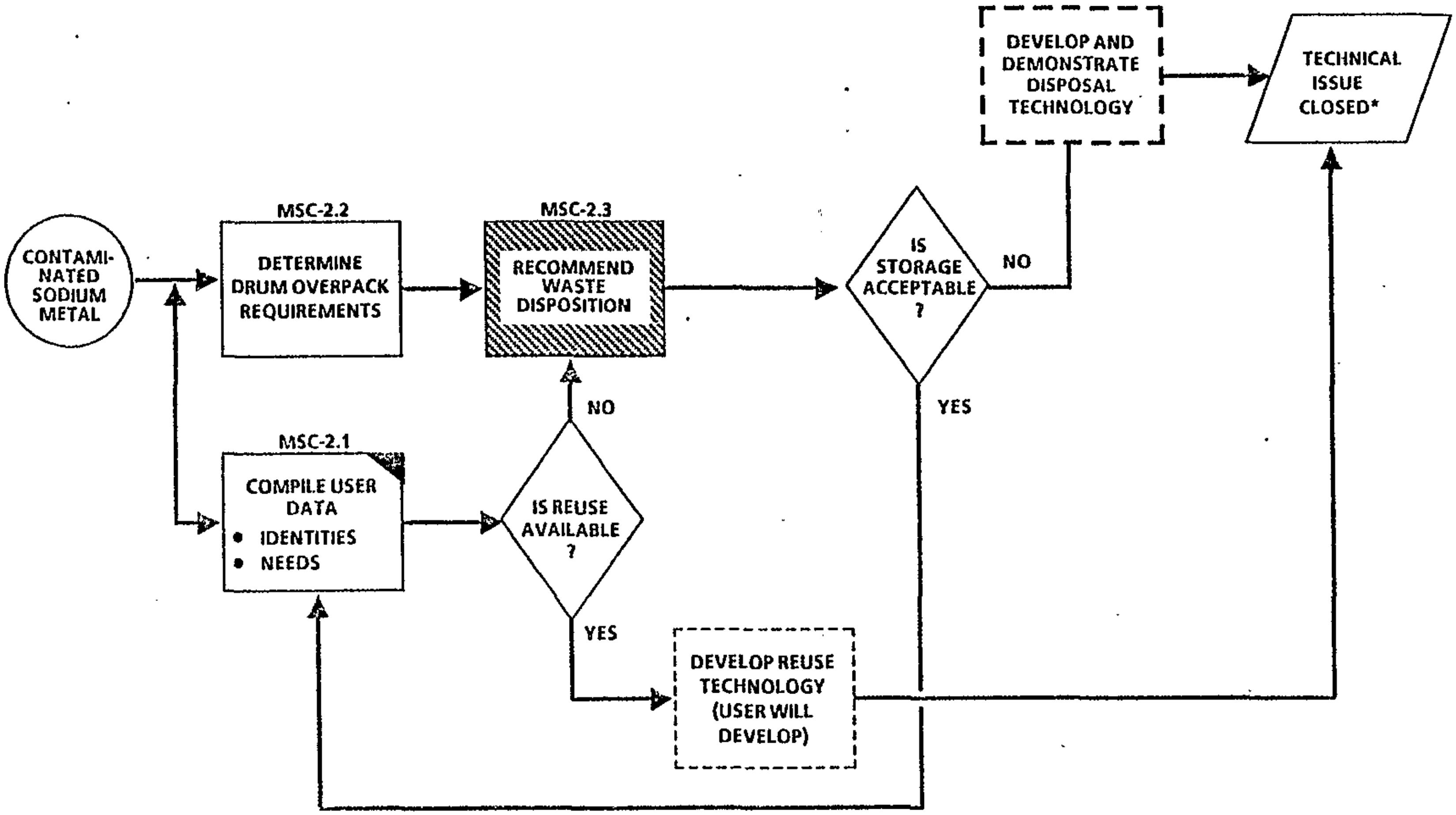
Figure XI-4 illustrates the logical order of performing the tasks required to close the contaminated sodium waste technical issue.

Costs to Close the Issue

Manpower: $70,000

Key Technical Decisions

No key technical decisions were identified as being required for assuring the safe interim storage of contaminated sodium wastes or for development of disposal technology.



*TECHNOLOGY FOR REUSE OR FINAL DISPOSAL IS DEVELOPED.

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FIGURE XI-4. Flow Diagram MSC-2--Contaminated Sodium Metal.

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XII. ENHANCED TECHNOLOGY BASE

The reference disposal plan presented in the HWMP for the various kinds of HSDW is necessarily based upon the present state of radioactive waste management/disposal technology. Similarly, technical issues and tasks identified in the HWMTP also reflect, to a large extent, this current technological base.

But, new waste management/disposal technology is continually being developed at various DOE laboratories and sites as well as abroad. Some of these new developments may have a significant and favorable impact upon the choice of the reference plan for disposal of HSDW or upon selection of various process steps in the reference plan. In recognition, therefore, of the need to keep abreast of evolving technology, technical issues related to providing for an Enhanced Technology Base are identified in the HWMTP.

Two of the Enhanced Technology Base issues (ETB-2 and -3) in this edition of the HWMTP involve development of new chemical separations procedures which may be applicable as cost-effective process steps for preparing NCAW sludges for vitrification. A third issue (ETB-1) concerns timely acquisition of technology to manage and dispose of potential future Hanford Site wastes.

Future editions of the HWMTP will include other Enhanced Technology Base issues.

A. SCHEDULES

Schedules for resolving the enhanced technology base technical issues are shown in Figure XII-1.

B. COST SUMMARY

Table XII-1 summarizes the costs associated with development of technology to close the ETB issues.

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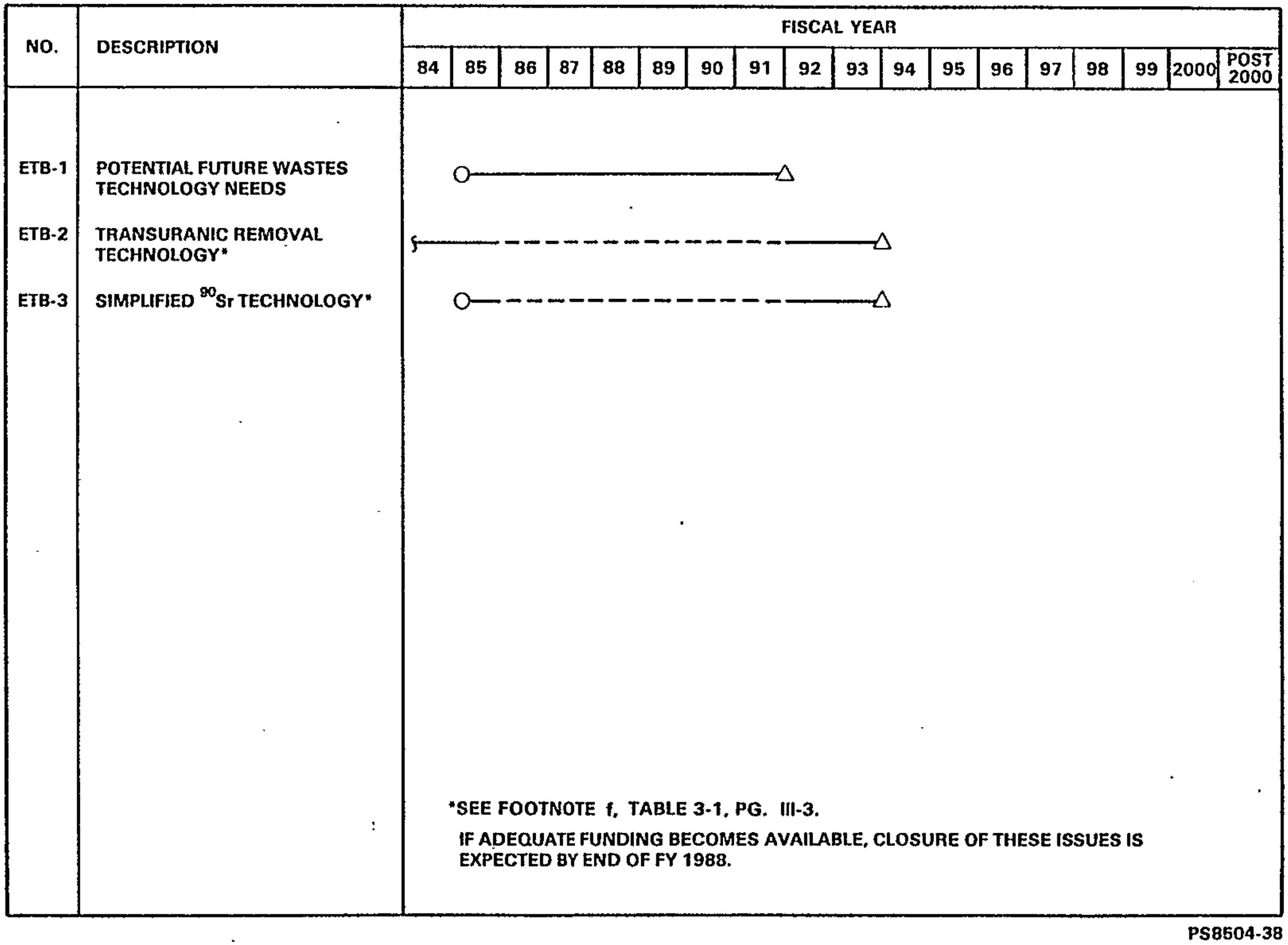

FIGURE XII-1. Schedules for Resolving ETB Technical Issues.

TABLE XII-1. Estimated Technology Development Costs--Enhanced Technology Base.

Technical issue: Identification symbol	Technical issue: Title	Estimated costs ($1,000): Manpower	Estimated costs ($1,000): Material	Estimated costs ($1,000): Total
ETB-1	Potential Future Wastes Technology Needs	$1,510	$100	$1,610
ETB-2	TRU Removal Technology	1,000	100	1,100
ETB-3	Simplified ^{90}Sr Removal Technology	812	100	912
	TOTAL (rounded)	$3,320	$300	$3,620

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Technical Issue ETB-1

POTENTIAL FUTURE WASTES - TECHNOLOGY NEEDS

Statement of Issue

The technical issue is: What are the potential future new radioactive defense wastes to be generated at the Hanford Site, and what technology needs to be developed to safely manage and dispose of such wastes?

Several new major Hanford site production-scale facilities and/or plant modifications e.g., Special Isotopes Separation, PUREX Facility modifications (PFM), etc. are in various planning stages. These and other future Hanford facilities and missions will generate radioactive liquid and solid wastes (e.g., cladding hulls) which must be accommodated in the overall HWMP. Applied technology development in support of the HWMP must be flexible enough to anticipate and provide the procedures, techniques, and special equipment required for safe and cost-effective interim storage and final disposal of future types of radioactive wastes. Provision for acquisition of the needed applied technology is the concern of this issue.

Scope

Encompassed in the scope of this issue are activities relating to:

- Collection and compilation of data and information relating to planned or projected new Hanford production or research facilities and the expected types, amounts and production rates of radioactive waste they will generate. Data concerning waste compositions, both radioactive and inert, and the chemical and physical properties will be of particular importance.
- Engineering analyses and evaluations to determine how future inventories of waste can be managed and disposed of and to identify and plan for acquisition of new technology needed to accommodate future wastes.

Status

Considerable experience was gained at the Nuclear Fuels Services Plant in New York State in shear-leach processing of N-Reactor fuels. Engineering studies of potential shear-leach processing of N-Reactor fuel in the PFM have been performed; tentative procedures for handling and disposing of cladding hulls resulting from such processing have been formulated.

Tasks to Close the Issue

The following tasks are needed to close the issue of technology needs for potential future wastes:

ETB-1.1 Project wastes from new facilities

Conduct an engineering study to prepare a summary of anticipated types, amounts, compositions, and properties of radioactive waste to be generated by planned future or projected new Hanford site production and research facilities; update this summary annually or as required. ($40,000)

ETB-1.2 Determine technology needs

Perform engineering studies to analyze, evaluate, and recommend technology development work needed to manage and dispose of potential future wastes from new facilities. ($140,000)

ETB-1.3 Develop needed technology

Conduct to-be-determined studies and tests to devise, develop, and demonstrate technology for management and disposal of future Hanford defense wastes. ($1,430,000)

Flow Diagram

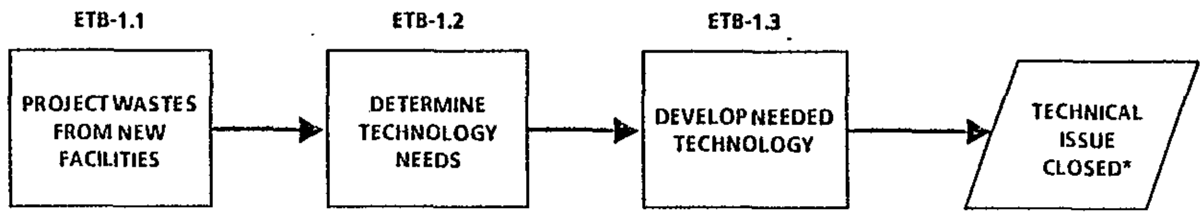
Figure XII-2 illustrates the logical order of performing the tasks required to close the issue of technology needs for potential future wastes.

Costs to Close the Issue

Manpower: $1,510,000
Materials: $100,000

Key Technical Decisions

No key technical decisions were identified as being required to develop needed technology for potential future wastes.



*TECHNOLOGY FOR MANAGEMENT AND FINAL DISPOSAL OF FUTURE WASTES IS AVAILABLE FOR IMPLEMENTATION.

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FIGURE XII-2. Flow Diagram ETB-1--Potential Future Wastes - Technology Needs.

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Technical Issue ETB-2

TRANSURANIC REMOVAL TECHNOLOGY

Statement of Issue

The technical issue is: On the basis that removal of TRU elements from various PUREX acidic waste solutions may be desirable or necessary, what separations processes need to be developed and/or tested to provide the optimum suite of reliable TRU removal procedures?

Availability and implementation of technically and economically feasible TRU removal processes could significantly impact the choice of disposal locations (geologic repository vs. near-surface disposal) and the costs of disposal of future PUREX wastes. This issue relates to identification and statement of the engineering and laboratory studies which should be performed to define practicable TRU element removal technology.

Scope

Future PUREX Plant high-level waste produced from processing N-reactor and other irradiated fuels will contain much greater than 100 nCi/g of ^{241}Am (and smaller amounts of Pu and ^{237}Np) and will, therefore, by present standards (DOE, 1984), be a TRU waste.

The scope of the needed technology includes:

- Analytical determination of the TRU content of actual PUREX wastes
- Laboratory studies with simulated and actual TRU waste solution to develop and demonstrate technically feasible solvent extraction and precipitation processes for reduction of TRU levels to or below 100 nCi/g
- Engineering studies to define plant-scale TRU removal process operability and economic feasibility.

Status

Bifunctional organophosphorous reagents are currently being studied at Argonne National Laboratory (ANL) and appear particularly well-suited for extraction of americium and other TRU elements from acidic nitrate solutions (e.g., PUREX process acidified sludge). An engineering study (Vandegrift, et al, 1984) to develop preliminary chemical flowsheets for removal of TRU elements from acidified PUREX sludge is in the planning stage.

Well-known and simple precipitation technology (e.g., precipitation of lanthanum fluoride) may also be useful in providing efficient removal of TRU elements from acid PUREX TRU removal wastes; the scope of this issue includes consideration of all applicable processes.

Tasks to Close the Issue

The following tasks close the issue of technology for removal of TRU elements from future PUREX wastes:

ETB-2.1 Determine incentives and feasibility of TRU removal from PUREX CAW, and NCAW wastes

Conduct an engineering study to assess feasibility, cost and technology development requirements for removal of TRU elements. Identify alternative methods for further testing. ($55,000)

ETB-2.2 Bench- and pilot plant-scale testing

Alternative TRU removal process will be tested on a bench- and pilot plant-scale. Alternatives to be tested include liquid-liquid extraction, scavenging precipitation, and leaching or solubilization from neutralized waste sludge. ($535,000)

ETB-2.3 Select most promising alternative

Based on test data, the economic attractiveness and technical feasibility of alternative processes will be reassessed and the most attractive alternative will be selected for plant-scale testing. ($10,000)

ETB-2.4 Plant-scale testing of most promising alternative

Production-scale tests will be conducted to demonstrate operability and to establish production costs. ($400,000)

Flow Diagram

Figure XII-3 illustrates the logical order of performing the tasks required to close the TRU removal technology issue.

Costs to Close the Issue

Manpower: $1,000,000
Materials: $100,000

Key Technical Decision

- Is TRU removal desirable and feasible?

A "no" answer would eliminate the need to perform all but the first task. The total savings would be $945,000.

Bibliography

DOE (1984), Radioactive Waste Management, DOE-5820.2 (Interim Draft), U.S. Department of Energy, Richland, Washington.

Vandegrift, G. F., R. A. Leonard, M. J. Steindler, E. P. Horwitz, L. J. Basile, H. Diamond, D. G. Kalina, L. Kaplan (1984), Transuranic Decontamination of Nitric Acid Solutions by the TRUEX Solvent Extraction Process--Preliminary Development Studies, ANL-84-85, Argonne National Laboratory, Argonne, Illinois.

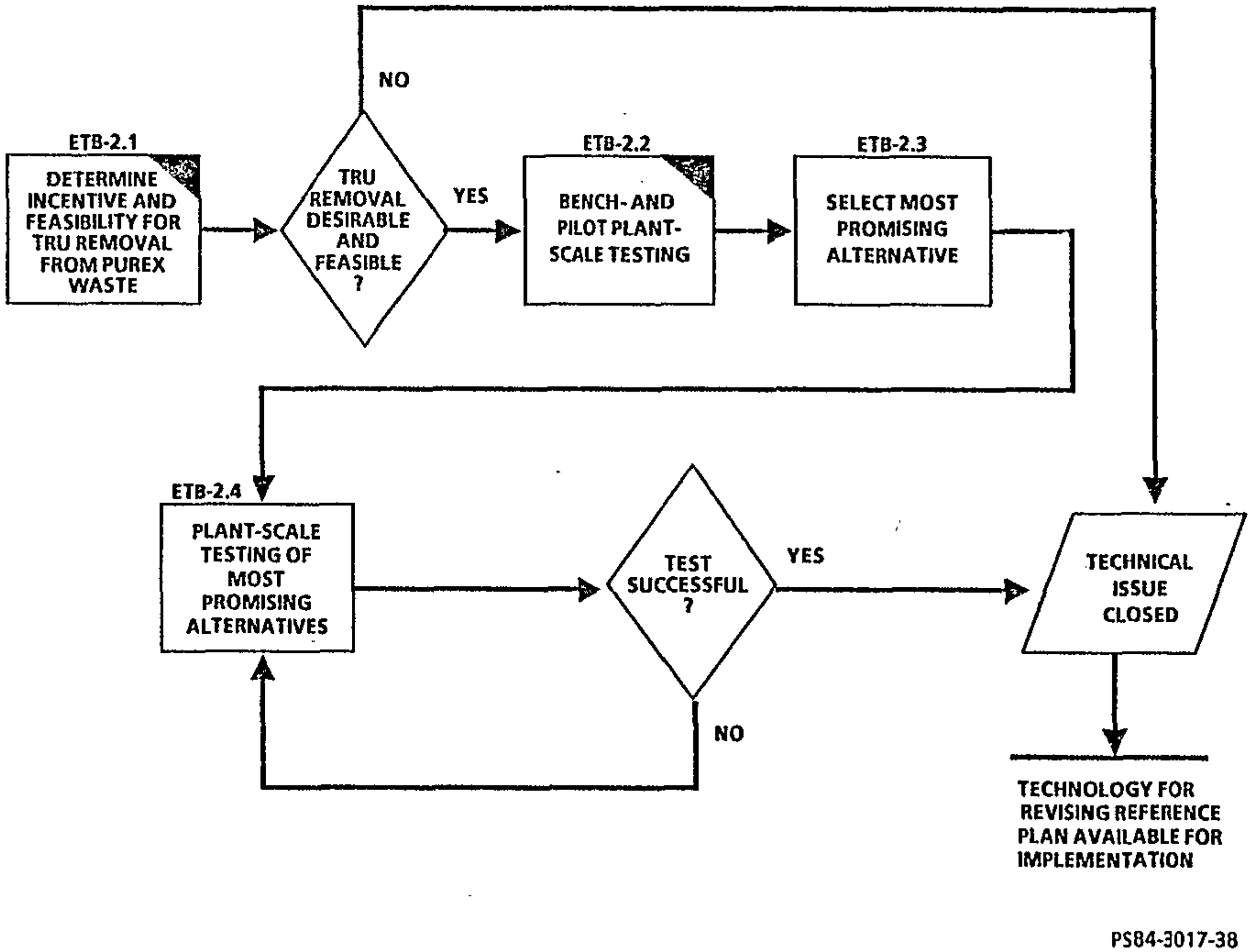

FIGURE XII-3. Flow Diagram ETB-2--Transuranic Removal Technology.

Technical Issue ETB-3

SIMPLIFIED ^{90}Sr REMOVAL TECHNOLOGY

Statement of Issue

The technical issue is: On the basis that removal of ^{90}Sr from future PUREX process waste (CAW solutions and/or acidified sludge) may eventually be desirable and/or necessary, how can such recovery be accomplished without use of objectionable organic complexing agents?

Available radiostrontium recovery processes involve the use of organic reagents (complexants) which excessively complicate management and disposal of the ^{90}Sr-depleted waste. New and more economical ^{90}Sr recovery processes, which avoid or minimize the use of troublesome organic complexants and chelating agents and are less complex and labor-intensive, need to be developed and demonstrated. This issue describes a suite of technical tasks for achieving this latter goal.

Scope

A solvent extraction process employing *bis*(2-ethylhexyl)phosphoric acid (HDEHP) has been used successfully in the Hanford B plant since 1967 to recover and purify ^{90}Sr from various waste solutions. This process involves adjustment of the waste to pH 4 to 5 and addition of various organic reagents (complexants) such as sodium ethylenediaminetetraacetate (Na_4EDTA), etc. to prevent precipitation of metals such as iron and aluminum. Organic complexants remain in the aqueous raffinate from the HDEHP extraction step and, because of their great stability, complicate disposal of the ^{90}Sr-depleted waste. Large amounts of sodium (as sodium hydroxide and sodium salts of complexants) added to high-level waste solutions in the HDEHP strontium extraction process are also a disadvantage in that more tank space is required to store the ^{90}Sr-depleted waste fraction. Alternative and improved ^{90}Sr recovery processes which overcome the disadvantages of the HDEHP process need to be developed and demonstrated through a sequence of bench- and pilot-plant scale tests with simulated and actual waste solutions.

The scope of this issue also includes analyses of possible benefits to waste disposal operations of ^{90}Sr removal. The impact of aged waste with most of the major radiation sources (cesium and strontium) removed upon shielding, handling, and transportation requirements needs to be investigated.

Status

Two alternative processes which appear potentially attractive for recovery of ^{90}Sr from selected Hanford solutions are known: e.g., (1) Sorption from strong nitric acid (HNO_3) solution on antimonic acid ($Sb_2O_5.4H_2O$) (Clearfield, 1982) and (2) solvent extraction by *bis*(hexoxyethyl)phosphoric acid (HDHoEP) from pH 1-2 feeds.

Baetsle and Hays (1968) have conducted extensive batch and column studies of antimonic acid sorption of ^{90}Sr from 1-7M HNO_3 solutions. Recent scouting studies in Rockwell laboratories indicate a once-through process involving contacting a large volume of waste solution with a small weight of $Sb_2O_5.4H_2O$ may be technically and economically feasible. The ^{90}Sr loaded antimonic acid can be fused with potassium hydroxide and the resulting melt taken up in water to solubilize the antimony and precipitate $^{90}Sr(OH)_2$. After discarding the antimony solution, well-known aqueous chemistry can be used, if desired, to purify the ^{90}Sr. (Alternatively, in a dry process, treatment of dried antimonic acid containing ^{90}Sr with HCl gas at 350°C volatilizes antimony as $SbCl_5$, leaving a small volume of $SrCl_2$ which can be further purified.) Successful development of a batch antimonic acid ^{90}Sr sorption process directly applicable with HNO_3 solutions could eliminate the need for organic complexants and would also eliminate the need to add large amounts of sodium salts to the waste.

Workers at the Argonne National Laboratory report that the commercially available reagent HDHoEP efficiently extracts ^{90}Sr from oxalate-complexed pH 1-2 solutions from which TRU and rare earths have previously been extracted. Oxalate is used to prevent precipitation of iron and aluminum and, although oxalate is an organic material, it can be destroyed much easier than EDTA, etc. Also, oxalate in ^{90}Sr-free waste solution may not be troublesome with regard to disposal of such wastes.

A well-known precipitation process (e.g., $SrHPO_4$, etc.) may also be applicable to simple and effective removal of ^{90}Sr from some Hanford waste solutions.

Tasks to Close the Issue

The following tasks close the issue of simplified ^{90}Sr recovery processes:

ETB-3.1 Determine need for additional ^{90}Sr removal

Determine incentives for additional ^{90}Sr removal from new and existing waste from waste management and beneficial use standpoints. ($32,000)

ETB-3.2 Identify potentially attractive new ^{90}Sr removal processes

Perform literature reviews and assessments and conduct limited laboratory exploratory studies to identify promising new ^{90}Sr removal technology which can be developed further as needed. ($40,000)

ETB-3.3 Assess incentives for a new ^{90}Sr removal process

Conduct engineering studies to address the technical and economic feasibility and technology development needs of alternative processes such as antimonic acid sorption, phosphate scavenging and extraction with *bis*(hexoxyethyl) phosphoric acid (HDHoEP). Alternative costs will be compared to the cost of the existing process including complexant destruction. ($120,000)

ETB-3.4 Bench- and pilot plant-scale tests of alternative processes

Attractive alternative processes will be tested, guided by technology development needs identified in the preliminary engineering studies. ($400,000)

ETB-3.5 Select most promising alternative

Utilizing test data, the economic attractiveness and technical feasibility of alternative processes will be reassessed and the most attractive alternative will be selected for a plant-scale test. ($70,000)

ETB-3.6 Plant-scale testing of most promising alternative

Full production-scale tests will be conducted to demonstrate operability and to establish production costs. ($150,000)

Flow Diagram

Figure XII-4 illustrates the logical order of performing the tasks required to close the issue of simplified ^{90}Sr removal technology.

Costs to Close the Issue

Manpower: $812,000
Materials: $100,000

Key Technical Decisions

- ETB-3 (1): Is the removal of additional ^{90}Sr from new and existing waste needed?

A "no" answer would eliminate all but the first task. The total savings would be $780,000.

- ETB-3 (2): Is there an incentive to develop a new ^{90}Sr removal process?

A "no" answer would eliminate the following tasks:

  - Bench- and pilot plant-scale testing of alternative processes. ($400,000)
  - Select most promising alternative. ($70,000)
  - Plant-scale testing of most promising alternative. ($150,000)

The total savings would be $620,000.

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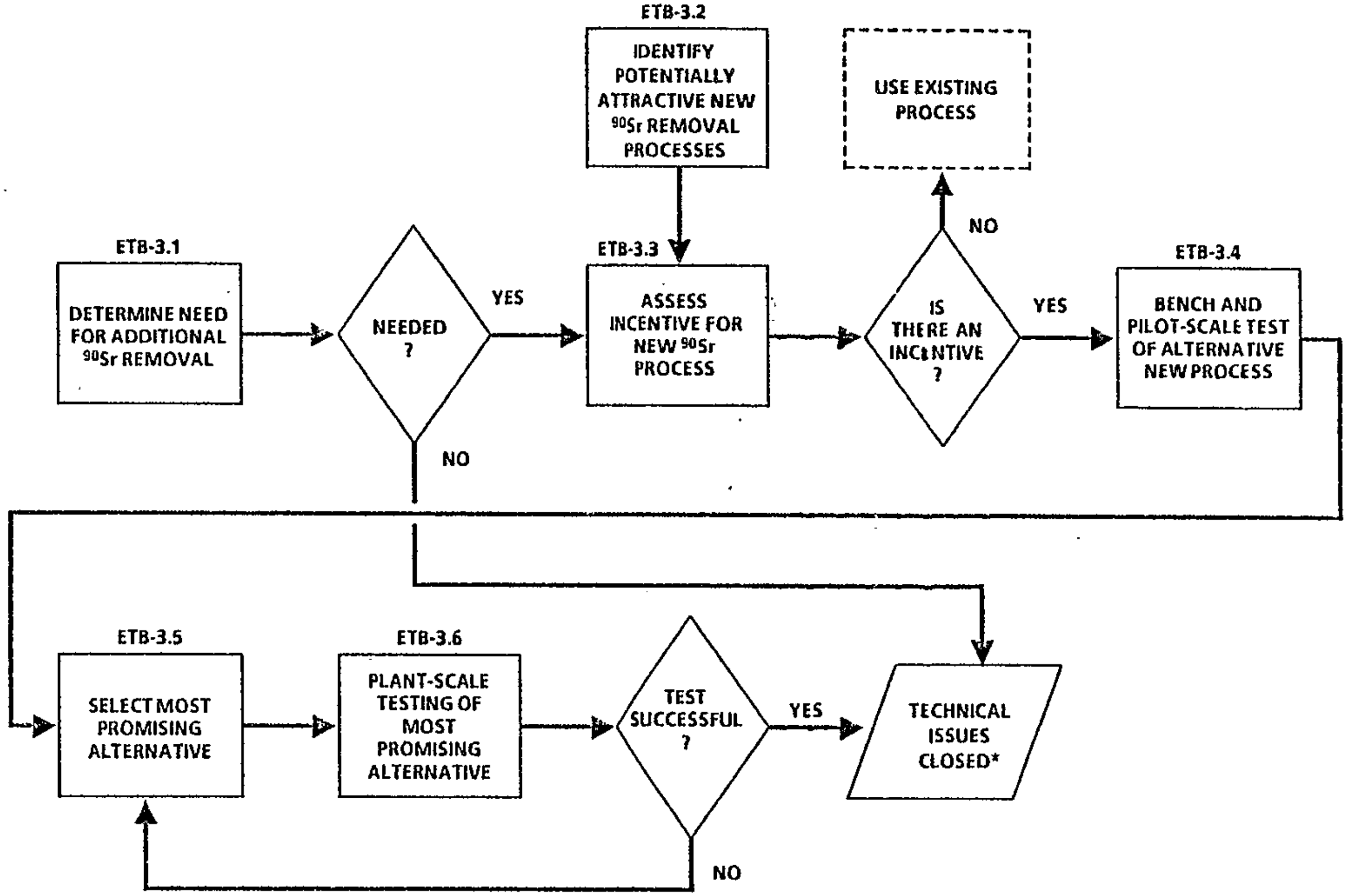

*TECHNOLOGY FOR SIMPLIFIED ^{90}Sr REMOVAL AVAILABLE FOR IMPLEMENTATION.

PS84-3017-11

FIGURE XII-4. Flow Diagram ETB-3--Simplified ^{90}Sr Removal Technology.

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APPENDIX A

GLOSSARY OF HANFORD TERMS

A

Acceptable Corrosion Rate - that rate of surface removal permissible, based on back calculations from a vessel design life, original thickness, and minimal thickness for strength and integrity.

Actinides - elements with atomic numbers above 88. Common actinides for Hanford waste management include Th, U, Np, Pu, Am and Cm.

Active Institutional Control - for purposes of this document this will consist of continued federal control of Hanford along with maintenance and surveillance of facilities and waste sites.

Active Subsidence Control - (see also subsidence and subsidence accommodating barrier.) This consists of engineering techniques such as pile driving, dropping weights, and grout injection intended to minimize future subsidence.

Aging Waste - term usually reserved for high activity and/or heat waste which must be stored until it sufficiently decays to allow processing and/or disposal, generally associated with PUREX NCAW.

ALARA - as low as reasonably achievable, a concept adopted at Hanford whereby an attempt is made to reduce an emission or exposure level below established regulations based on cost/risk trade-off evaluations.

Atmosphere, Control of - in this document it refers to engineered regulation of the environment within a facility and usually consisting of a maintained negative pressure and/or an inert gas blanket.

B

Biosphere - that combination of the portions of the atmosphere, lithosphere and hydrosphere which supports plant and animal life on earth, the life zone.

Bismuth Phosphate Process - (see also extraction.) One of the earliest separation techniques used at Hanford to separate Pu from irradiated U fuels. Later replaced by REDOX and PUREX, which were more efficient processes.

Burial Ground - (see also trench, overburden, vault, caisson.) Land area specifically designated to receive contaminated waste packages and equipment, usually in trenches covered with overburden.

BWIP - Basalt Waste Isolation Project, (see also repository), Hanford investigation into the suitability of deep basalt flows for disposal of wastes.

Byproduct - certain radioisotopes produced at Hanford along with the primary Pu product which may have other uses. Examples are Cs, Sr, Pd, Ru, Rh.

C

Caisson - an underground structure used to store high activity wastes. Typical designs include corrugated metal or concrete cylinders 8 ft to 9 ft in diameter, 55 gal drums welded end-to-end, and vertical steel pipes below grade.

Canister - container for high activity waste such as Cs or Sr capsules or vitrified wastes (borosilicate glass).

Capsules - (see also WESF, Hastelloy, fractionization) - CsCl stored in stainless steel capsules and SrF_2 stored in Hastelloy capsules in WESF water basins.

CAW - current acid waste, the high-level waste stream from PUREX containing most of the fission products from the dissolved fuel.

Centrifugation - a solids/liquids phase separation technique utilizing the force inherent in rotating bodies which impels material outward from the center.

Characterization - the identification of components in a waste or contaminated material. Usually includes measurement of quantifies, mapping of locations and other similar properties and data.

Complexants - chemicals, usually organics, which assist in chelating (a type of chemical bonding) metallic atoms, examples include citrates, EDTA, HEDTA.

Complexed Concentrate (CC) - (or concentrated complexant), material containing high concentrations of complexants and stored in double-shell tanks, usually from waste fractionization.

Contact-Handled Waste (CH) - waste, usually packaged in some form, which emits low enough radiation levels (less than 200 mR/hr) to permit close and unshielded manipulation by workers.

Crib - an underground structure (e.g. open wooden box) designed to receive liquid waste which can percolate into the soil directly and/or after traveling to a connected tile field.

Criteria - general guidelines or principles from which more quantitative or definitive standards are derived to regulate activities.

CRW - cladding removal waste - chemical wastes resulting from the dissolution of the metal sheath or coating surrounding fuel elements. Usually contaminated with activation products, fission products and some TRU.

Customer Wastes - Hanford term used to identify wastes generated by other contractors (besides Rockwell) on the site. These wastes are concentrated to DSS and usually end up in double-shell tanks. These wastes have been renamed Hanford Facility Wastes (HFW).

D

D and D - decontamination and decommissioning - the fixation, clean-up, dismantling, and/or entombment of surplus equipment or facilities.

Daughter Product - a product of radioactive decay of a parent radioisotope which itself may produce daughters or be a stable end of a decay chain.

Defense Waste - radioactive waste from any activity performed in whole or in part in support of DOE atomic energy defense activities. The term excludes radioactive waste under purview of the Nuclear Regulatory Commission or generated by the commercial nuclear power industry.

Department of Energy Radioactive Waste - radioactive waste generated directly by activities of the Department (or its predecessors) and its contractors or subcontractors or other radioactive waste for which the Department is responsible. Such waste may be referred to as DOE waste.

Disposal - emplacement of waste in a manner that assures isolation from the biosphere without maintenance and with no intent of retrieval and that requires deliberate action to gain access to the waste after emplacement.

Distribution Box - an underground or in plant enclosure containing jumpers or valved manifolds which enable solution transfers via pipelines between various processes and storage facilities.

Ditch - (see also ponds) - an open trench used for conducting liquid waste streams from facilities usually to ponds.

DOE - Department of Energy - the federal agency responsible for the management of the Hanford Site.

Dome Fill - material for backfilling the open space above wastes in single- and double-shell tanks.

DSS - Double-Shell Slurry - product of concentration of non-complexed waste to a solid-liquid matrix; gets its name from storage in DSTs.

Double-Shell Slurry Feed - dilute feed, from various sources, to the evaporator crystallizer. Product is double-shell slurry, (DSS).

Double-Shell Tank (DST) - a reinforced concrete underground vessel with a double steel liner to provide backup containment of liquid wastes. Annulus is instrumented to permit detection of leaks through the inner liner.

Drainable Liquid - liquid in waste storage tanks which can migrate by gravity through the saltcake or sludge such that it could leak out of an impaired tank liner.

Drywell - a drainage receptacle constructed by digging a hole and refilling with coarse gravel. Also a water tight well casing used for inserting monitoring equipment.

DWMP - Defense Waste Management Plan - a plan prepared in response to Public Law 97-90 that sets forth plans for the disposal of high-level and transuranic wastes resulting from atomic energy defense activities.

E

Encapsulated Waste - (see capsules)

Engineered Barrier - a manmade structure designed to interdict as many waste migration pathways (e.g., animal burrows, plant roots, erosion, water infiltration) as possible and necessary depending on waste mobility, hazard and lifetime.

Enhanced Technology - refers to the need to maintain a viable position with respect to evolving technology which will provide for an upgraded ability to respond (in a cost-effective manner) to Hanford waste management program needs.

Environmental Assessment - (see also NEPA) (see 40 CFR 1508.9) - first major process in "NEPA plan" which determines if an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI) is appropriate.

Evaporator/Crystalizer - Hanford facilities to reduce the moisture content in HLW to minimize the danger from potential tank liner failures.

Extraction - (see also bismuth phosphate, TBP, PUREX and REDOX) - the mass transfer of an element or compound between two immiscible phases.

F

FFTF - Fast Flux Test Facility - Facility of Hanford Site currently operated by Westinghouse for the testing of fuels, materials, and designs related to breeder reactor technology.

FONSI - Finding of No Significant Impact (see NEPA) (see 40 CFR 1508.13) - a determination that an EIS is not needed, made by preparing an Environmental Assessment.

Fractionization - specifically, internal reflux within a bubble cap column resulted in separation between high and low boiling fractions. Also applied to isotope separations to reduce heat content of HLW.

French Drain - subsurface soil drain for disposal of relatively low volume, low activity solutions similar in basic design principles to a tile field/crib arrangement.

FRP Plywood Box - fiberglass reinforced plywood, a commonly used package for storing and burying LLW and TRU waste.

G

Geologic Disposal - a waste management alternative which achieves permanent disposal of high-level and TRU waste by storage in a deep geologic repository.

Greater Confinement - a technique for disposal of waste that uses natural and/or engineered barriers which provide a degree of isolation greater than that of shallow land burial but possibly less than that of a geologic repository.

Grout - a fluid mixture of cement, water, flyash, and clay used for waste fixation or immobilization.

Grout Plant - facility to be built at Hanford to combine low-level, CRW, DSS, and/or customer wastes etc. with a grout binder for subsequent placement in trenches or tanks or injection into solid waste sites.

H

Hanford Facility Waste (HFW) - Hanford term used to identify wastes generated by other contractors (besides Rockwell) on the site. These wastes are concentrated to DSS and end up in double-shell tanks.

Hanford Waste Vitrification Plant (HWVP) - (see vitrification) A facility designed to process Hanford HLW or TRU to borosilicate glass and package the glass in steel canisters. Plant is scheduled for operation in FY 1994.

Hastelloy - a special nickel-based alloy with corrosion resistant properties and used at Hanford for encapsulating strontium fluoride.

Hazardous Waste - at Hanford this term usually addresses nonradioactive chemical toxins or otherwise dangerous materials such as sodium, heavy metals, beryllium, and some organics.

HDW-EIS - Hanford Defense Waste - Environmental Impact Statement - an evaluation of various management strategies for HLW and TRU waste.

Heat Content - usually refers to the amount of fission products generating heat through radioactive decay contained in a tank or capsule.

Helium Leak Check - a method used during encapsulation at WESF to ensure the integrity of weld seals on capsules.

HEPA Filters - High Efficiency Particulate Air - Material which captures entrained particles from an air stream, usually with efficiencies in the 99.95% and above range. Filter material is usually a paper or fiber sheet pleated to increase surface area.

High-Level Waste (HLW) - the highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of TRU waste and fission products in concentrations as to require permanent isolation.

HSDW - Hanford Site Defense Wastes - comprises all existing and certain future radioactive wastes generated at the U.S. Department of Energy Hanford Site including single-shell and double-shell tank wastes; solid and liquid waste burial sites; encapsulated $^{137}CsCl$ and $^{90}SrF_2$; stored and new TRU solid wastes; and

HWMP - Hanford Waste Management Plan

HWMTP - Hanford Waste Management Technology Plan - a companion document to HWMP which provides greater detail on the technical tasks needed to resolve the technical issues identified in HWMP.

Hydraulic Sluicing - a method for removing DSS from double-shell tanks by dissolving/suspending in water and pumping out. Usually followed by concentration in an evaporator/crystallizer.

I

Immobilization - a process such as grouting or vitrification designed to inhibit waste mobility.

Inadvertent Intrusion - human activity such as home excavation, resource mining, and well digging which accidentally breaches a waste site.

Institutional Control - at a minimal level this would consist of continued control over the site in terms of legal ownership by the government.

In Situ Immobilization - an in place technique such as pressure grouting or electrode glassification which solidifies wastes to inhibit mobility.

Interim Storage - a management policy of controlling waste until such time that an ultimate disposal plan is approved and implemented.

Interstitial Liquor - the liquid which fills the void in a solid. In the waste tanks, this liquid may be evaporator feed or Hanford defense residual liquor, and is estimated to be 30 to 50 percent of the solids. About 40 percent of the liquid in salt cake is held in place by capillary forces and will not drain (nondrainable). In the sludge portion of the tank farm waste, none of the liquor is normally considered pumpable or drainable.

Isolation - attempt to seclude waste from the biosphere (see also immobilization, engineered barrier, waste form).

Issue - a technical question or uncertainty of such significance that it must be answered or solved before specific waste disposal plans can be satisfactorily implemented.

J

Jet Pumping - a technique for removing interstitial liquor from single-shell tanks.

L

Low-Level Waste (LLW) - radioactive waste not classified as high-level waste, TRU waste, spent nuclear fuel, or byproduct material.

Liquid Waste Disposal Site - an engineered structure used for discharge of contaminated liquids to the ground. In the HWMP these sites are referred to as "contaminated soil sites."

Low-Level Wastes - non-TRU, non-HLW which still contains sufficient radioactivity to require some isolation from the biosphere.

M

Marker - a surface or subsurface monument or plaque of durable material containing a warning and/or information message designed to prevent inadvertant intrusion.

Mechanical Recovery - a means of removing wastes from an underground storage tank without using water due to a possible risk of leakage (usually single-shell tanks). Often conceptualized as a mining technique using a clam-shell scoop.

MIBK - methyl isobutyl ketone (hexone) a solvent used at the REDOX separations plant.

N

NCAW - neutralized current acid waste.

Near Surface - a somewhat arbitrary location designation for wastes not disposed of in deep geologic repositories.

NEPA - National Environmental Policy Act - as outlined in 40 CFR Parts 1500-1508, a formal and specific plan mandated for provision of environmental documentation.

Neutralization - the buffering of acidic wastes with an alkali (such as $NaOH$, $Ca(OH)_2$, KOH) to increase the life of waste containers.

Non-Combustible - waste items such as concrete rubble and steel tools which will not support combustion under ordinary circumstances.

Nondestructive Assay (NDA) - analytical technique which can determine the presence and quantity of an element(s) without altering the matrix material.

Non-TRU - a waste which does not meet the definition of TRU.

NPH - normal paraffin hydrocarbons - a solvent used at PUREX consisting of straight chain hydrocarbons primarily in the C-10 to C-14 range.

NRC - Nuclear Regulatory Commission.

N Reactor Fuel - usually referring to irradiated fuel from Hanford's last production reactor currently being stored for the PUREX campaign.

O

Off-Gas Treatment - generic name for equipment designed to clean up vent gasses from processes. May consist of adsorbers, sand beds, gas flares, HEPA filters, etc.

Overburden - soil used to backfill an excavation containing solid waste or a liquid waste disposal structure.

Overpack - a thick steel canister designed to dissipate heat, shield, and contain Cs and Sr capsules.

Ozonization - a process for oxidizing (or destroying) complexants in recovered complexed concentrate from DSTs.

P

PFMP - Process Facility Modification Plant - a fuel processing headend facility, often called "chop-leach."

PFP - Plutonium Finishing Plant (Z Plant) - Hanford facility (234-5 building) which processes solid Pu compounds and metals.

Performance Assessment - an analysis which identifies events and processes which might affect the disposal system, examines their effects upon its natural and engineered barriers, and estimates the probabilities and consequences of the events and processes.

Ponds - sometimes called swamps. They are surface depressions used to contain low-level contaminated solutions.

Pre-Certified - solid TRU wastes packaged to meet requirements of WIPP-WAC.

PUREX - Plutonium Uranium Reduction/Extraction - latest in a line of separation technologies preceded by bismuth phosphate and REDOX.

R

REDOX - (an acronym for reduction - oxidation); a large radiochemical solvent extraction processing plant for the recovery and purification of uranium, plutonium, and neptunium, from irradiated fuel elements. The solvent methyl isobutyl ketone (Hexone) and the salting agent ANN were contacted in extraction columns packed with Raschig rings. The plant, the 202-S facility located in 200 West Area, was completed in 1952 and deactivated in 1967.

Remote Handled (RH) - (see contact handled) - waste emitting greater than 200 mR/hr but less than 100 R/hr and requiring shielding and distance from human operations.

Remote Sensing - monitoring at a distance as opposed to bringing sample and detector in direct contact.

Repository - (see also geologic disposal) - a land-based, deep disposal site for long-term isolation of HLW, often in salt, granite or basalt.

Retrievably Stored - interim stored waste retrievable with minimal risk and cost for further processing and/or disposal.

Reverse Well - an early Hanford liquid disposal waste structure consisting of a well (sometimes drilled into water table) into which waste solutions were pumped.

ROD - Record-of-Decision - concise statement for the public record, prepared after EIS is completed, of preferred alternative describing other alternatives and mitigating procedures to be adopted.

S

Salt Cake - crystallized nitrate and other salts deposited in waste tanks usually after active measures were taken to remove moisture content.

Salt Well - a hole drilled or sluiced into a salt cake and lined with a cylindrical screen to permit drainage and jet pumping of interstitial liquor.

Single-Shell Tank (SST) - older style Hanford HLW underground tank composed of a single carbon steel liner surrounded by concrete.

SIS - Special Isotope Separation - (see also PFP) - laser process for partitioning isotopes of Pu from one another.

Site Preparation - activities such as road building, bringing in power, surveys, etc. necessary before initiating waste disposal actions.

Sludge - primarily insoluble metal hydroxides and hydrated oxides precipitated from DNW and NCRW.

Sludge Washing - sludge cleanup with water in order to remove soluble "impurities" which would unnecessarily increase the resulting glass volume if the sludge were vitrified.

Soil Plume - the trail of contaminated soil left behind due to adsorption from a liquid waste discharge.

Solid Waste Burial Site - a land area specifically designated to receive contaminated solid waste materials for burial.

Stabilization - treatment of waste or a waste site to protect the biosphere from contamination spread.

Standard - a quantitative measure of criteria satisfaction.

Subsidence - gradual or catastrophic sinking of the ground surface below natural grade level due to collapse of a large void space or slow decay and compression of material.

Subsidence Accommodating Barrier - sometimes call a slump-and-fill barrier designed thick and rugged enough to withstand and self-heal as the waste below compacts or decays.

Sump - usually associated with other liquid waste disposal facilities, a sump is an underground tank often used to clarify wastes, permit addition of chemicals to waste, and/or provide an integrated sample reservoir.

Supernatant Liquors - usually refers to a distinct liquid phase resting on top of a solid layer.

Surveillance System - a network of sensors associated with recording devices and alarms to provide continuous monitoring of a site, facility, or area.

SWEPP - Stored Waste Examination Pilot Plant - a pilot facility at the Idaho National Engineering Laboratory (INEL), includes capabilities for nondestructive examination and assay of solid wastes.

T

TBP - tri-n-butyl phosphate - an organic extractant used at PUREX.

Technology Demonstration - specifically refers to a series of proposed, and currently underway, test applications of proposed waste management techniques.

TGF - Transportable Grout Facility.

Tiering - (see NEPA) - a method (see 40 CFR 1508.28) for preparing a network of environmental documents splitting off from a generic, broad EIS, with the intent of minimizing support documentation.

TRUSAF - TRU Storage and Assay Facility - a facility for assay and storage of transuranic solid waste materials.

TRU Waste - without regard to source or form, radioactive waste that at the end of institutional control periods is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g.

Tunnel - a large underground storage structure for large pieces of equipment often on railroad cars; PUREX storage tunnels.

Two Hundred (200) Area Plateau - highest portion (aside from Rattlesnake and Gable Mountains) on Hanford Site, containing most of the waste processing and storage facilities. Name derived from numbering system devised by duPont in early 1940's.

U

Unsegregated Solid Waste - waste buried prior to 1970 which was not separated according to TRU content, combustibility or any other criteria.

V

Vault - another type of solid waste storage structure similar to a caisson.

Vermiculite - a micaceous mineral that is a hydrous silicate, used as a packaging material or as an absorbent for liquid wastes.

Vitrification - a method of immobilizing HLW for eventual disposal in a geologic repository. Involves adding frit and waste to a Joule heated vessel and melting into a glass poured into a canister.

Void Space - air space either above waste in caisson or tank and/or within pores or interstices of a bulk material such as gravel or random barrels.

W

Waste Concentration - removal of excess water from liquid wastes or slurries.

Waste Form - usually the desired matrix or physical state for safe handling waste.

Water Basin - stainless steel lined concrete pool with water circulation and treatment for storing and cooling capsules.

WESF - Waste Encapsulation and Storage Facility a facility built for the purpose of receiving strontium and cesium solutions from B Plant and creating a solid, encapsulated product. Also includes water basins for capsule interim storage.

WIPP - Waste Isolation Pilot Plant.

WRAP - Waste Receiving and Processing (facility) a process plant to sort, shred, grout and package solid TRU waste.

APPENDIX B

INTERIM MANAGEMENT TECHNICAL ISSUES

This appendix contains descriptions of Technical Issues SST-1, CSS-1, and DST-2. These issues relate to technology needs for interim management of certain HSDW wastes rather than the disposal of these wastes.

NOTE: See discussion on page I-4 of main section of text.

Technical Issue SST-1

INTERIM MANAGEMENT

Statement of Issue

The technical issue is: What, if any, additional technology is required to continue safe interim storage of wastes in single-shell tanks and what work must be performed to provide the new technology?

Development of the technology to assure continued safe interim storage (i.e., prior to final disposal) of wastes in single-shell tanks (SSTs) is the concern of this technical issue. Proper priority needs to be given to timely acquisition of whatever technical improvements are needed to assure continued protection of personnel and the environment during the interim storage period.

Scope

Operation of single-shell tank farms has shifted from active management of liquid wastes to management of an isolated, solidified material (ERDA, 1975). Implementation of updated surveillance technology has been initiated (e.g., liquid observation well monitoring). Ongoing technology support needed for continued interim management of SSTs must be provided prior to final disposal at the tanks.

Status

Significant interim management technology has recently been developed and/or implemented. The structural integrity of single-shell waste tanks for continued storage has been evaluated (DeFigh-Price and Dahlke, 1983). Surveillance has been improved by the development of liquid observation wells and dry wells. Fifty-nine in-tank liquid observation wells are being installed and activated and 11 more are scheduled for installation.

Process tests to evaluate breathing filters as a method for ventilating stabilized and isolated single-shell tanks are ongoing.

Design of a configuration control system for waste tanks which includes accurate records of design location and condition of waste storage facilities has been completed.

Ventilation requirements for single-shell tanks were reviewed in FY 1984, and necessary upgrades were identified.

A thorough review of literature related to the safety and stability of ferrocyanide compounds such as those present in some Hanford single-shell tanks was conducted in FY 1984. It was concluded that the potential for exothermic reactions is very low; thus, no recognized safety hazards are posed.

Tasks to Close the Issue

The following tasks close the issue of interim management of SST wastes:

SST-1.1 Provide ongoing technology support for interim management

Provide ongoing technology support as needed to establish continued interim management of SST wastes. Changes to the existing surveillance methods will be justified by a technical basis. This task includes appropriate studies and analyses of the number of monitoring systems, their location, and frequency of measurements to achieve a program level of statistical confidence in monitoring results. ($300,000)

SST-1.2 Update SST configuration control (Completed)

Complete the design of a configuration control system which includes accurate records of design, location, and condition of SSTs. Update as necessary. (Completed in FY 1984)

SST-1.3 Review SST ventilation requirements (Completed)

Review ventilation requirements for SSTs and determine if upgrades are required. (Completed in FY 1984)

SST-1.4 Update candidate ventilation systems (Completed)

Screen, test, and select candidate updated ventilation systems. (Completed in FY 1984)

SST-1.5 Establish monitoring and sampling requirements (Completed)

Establish the level of sensitivity and accuracy of monitoring and sampling measurement systems. Determine if systems should be modified. (Completed in FY 1984)

SST-1.6 Test and update candidate monitoring and sampling system (Completed)

Screen, test, and select candidate modified monitoring and sampling system. (Completed in FY 1984)

SST-1.7 Evaluate potential for exothermic reactions (Completed)

Conduct appropriate literature reviews and laboratory studies to determine the potential for exothermic reactions in SSTs containing nickel ferrocyanide solids. (Completed in FY 1984)

SST-1.8 Define methods to mitigate exothermic reactions (Completed)

Define appropriate methods to eliminate or mitigate exothermic reactions. (Completed in FY 1984)

Flow Diagram

Figure V-3 illustrates the logical order of performing the tasks required to close this technical issue for SST wastes.

Costs to Close the Issue

Manpower: $300,000
Materials: $50,000

Key Technical Decision

No key technical decisions were identified as being required to assure adequate continued interim storage in SSTs.

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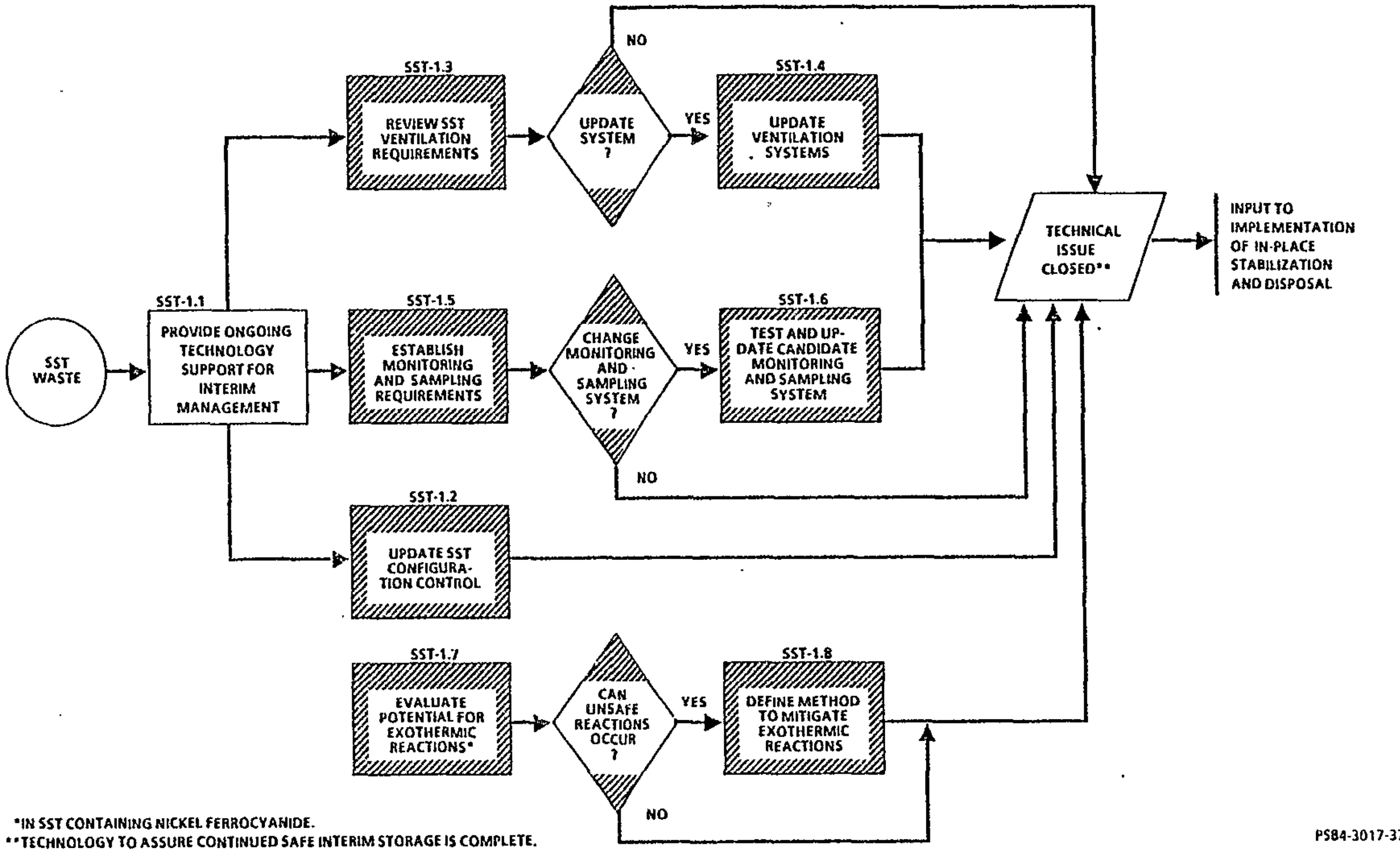


FIGURE B-1. Flow Diagram SST-1--Interim Management.

Technical Issue CSS-1

INTERIM MANAGEMENT

Statement of Issue

The technical issue is: Is there a need to provide upgraded technology for interim management of contaminated soil sites (CSS) resulting from the surface and subsurface disposal of low-level liquid and solid wastes? If upgraded technology is required, define what and how such technology should be realized.

Until additional or remedial action is taken, the CSS must be effectively monitored and maintained to assure safe access to the sites. The technical issue of concern here is to determine if there is a need and, if so, to provide and/or develop needed stabilization, surveillance, and maintenance technology for the CSS through the duration of the interim management period.

Scope

The interim management approach of surface stabilization previously applied to inactive solid waste sites will also be applied to inactive CSS beginning in the early part of FY 1985. This approach is intended to isolate all incoming lines to the site and to provide a site-surface free of contamination which will permit unrestricted site access for surveillance and maintenance personnel. These activities are required to assure containment of radionuclides discharged to these surface and subsurface disposal facilities.

Numerous design configurations have been utilized over the past 40 years for subsurface disposal of solid and low-level liquid wastes. Certain designs incorporated disposal structures which contained significant void space. Structures of this type present a potential hazard to both personnel and the environment in that total surface collapse could result from their deterioration.

Currently used stabilization and management procedures must be evaluated to determine their economic, industrial safety, radiological safety, and environmental safety adequacy.

Status

Significant interim management technology has already been developed and implemented. An engineering study for crib isolation and stabilization has been completed; studies for pond decommissioning are underway. Work is underway to define the approach to be taken to resolve questions regarding subsidence control, contamination control, radionuclide uptake by deep rooted vegetation, and subsequent safe site access for surveillance and maintenance activities.

Tasks to Close the Issue

The following tasks close the issue of interim management of contaminated soil sites associated with the disposal of low-level liquid wastes:

CSS-1.1 Complete the long-range plan for interim stabilization

Complete the long-range plan for the DOE FY 1989 milestone for the interim stabilization of all out-of-doors radiation sites, including the BC-crib control zone. Included in this plan will be a prioritized list of CSS along with generic and specific recommendations on the methodologies to be used for interim stabilization, monitoring and maintenance of the CSSs. ($90,000)

CSS-1.2 Complete studies for pond decommissioning

Complete engineering studies, work plans, and procedures for decommissioning U Pond and Gable Mountain Pond. Included in this task is the evaluation of the procedures used to stabilize pond disposal sites. ($80,000)

CSS-1.3 Develop procedures for site release and for postrelease monitoring of a site

Develop procedures for the release of surface contaminated sites along with procedures to monitor the site after it has been released. Develop statistical sampling designs for postrelease monitoring. ($100,000)

CSS-1.4 Evaluate methodologies for cleanup of surface contamination

Reevaluate procedures to remove or stabilize surface contamination, including the disposal of the contaminated material. ($30,000)

CSS-1.5 Review monitoring program

Evaluate sampling designs and monitoring programs currently being used for the interim management of CSSs. ($50,000)

CSS-1.6 Develop improved interim site stabilization covers

Review procedures used for interim site stabilization. Determine the feasibility of, and need for, improving covers, including use of geotextiles, time-release herbicides, and lay-down mats. Complete feasibility studies and test plans to test selected methods that offer cost benefits. ($50,000)

CSS-1.7 Evaluate methodologies for stabilization of pipelines

Perform an engineering study to evaluate the need and proper methods for interim stabilization of the distribution piping used in the various inactive disposal sites. ($30,000)

CSS-1.8 Develop load testing methodologies

Complete work on development and testing of methodologies for subsidence control in inactive CSSs. ($60,000)

CSS-1.9 Establish isolation criteria

Establish criteria and procedures for the isolation and stabilization of equipment used in association with inactive disposal sites such as vent piping, flow diversion equipment, etc. ($30,000)

CSS-1.10 Update site drawings

Update site drawings for all inactive out-of-doors waste sites. Included in this task is a mapping and confirmation of the contaminated area associated with each site. ($90,000)

CSS-1.11 Review methods for vegetation control

Review current methods for the control of deep rooted vegetation on the stabilized sites. ($30,000)

CSS-1.12 Evaluate equipment

Perform an engineering study to evaluate the equipment currently being used for the interim management of CSSs. ($20,000)

CSS-1.13 Review revegetation techniques

Reevaluate the procedures and criteria currently used to revegetate an inactive disposal site. ($20,000)

CSS-1.14 Evaluate alternatives for eliminating low-level waste discharge to soil columns

Complete a detailed analysis of the technical feasibility and cost of alternative methods for eliminating low-level waste (LLW) discharge directly to soil columns. Each waste stream will be evaluated against a set of several alternatives. A clear recommendation will be provided. ($200,000)

CSS-1.15 Test alternatives for eliminating low-level waste discharge to soil columns

Perform engineering studies and appropriate laboratory and pilot-scale tests required to implement the recommended disposal alternatives. ($500,000)

Flow Diagram

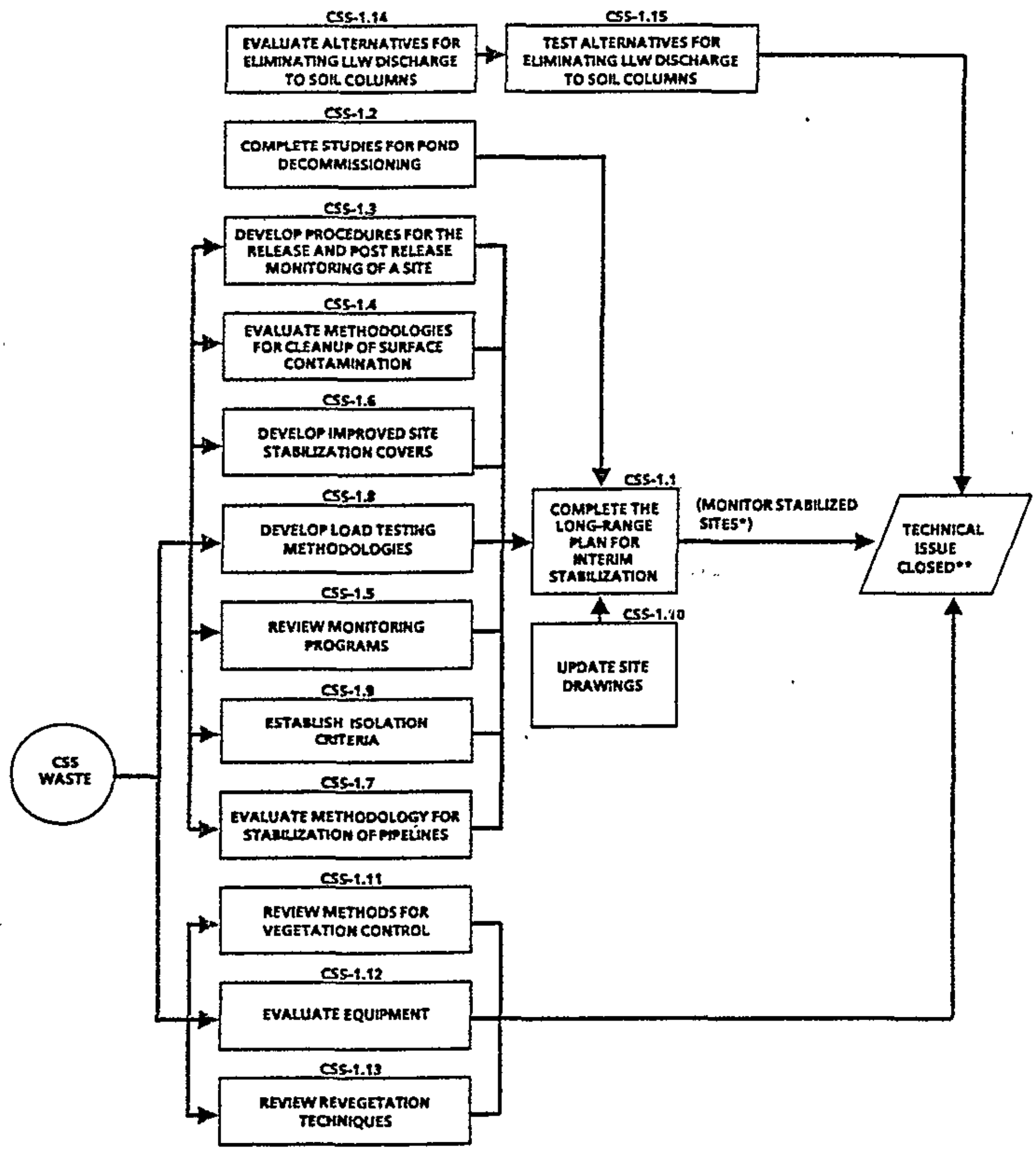
Figure B-2 illustrates the logical order of performing the tasks to close the interim management technical issue for contaminates soil sites.

Costs to Close the Issue

Manpower: $930,000

Key Technical Decisions

No key technical decisions were identified as being required to assure safe interim management of CSSs.



*PERFORMED BY THE INTERIM WASTE MANAGEMENT PROGRAM.
**ADEQUATE INTERIM MANAGEMENT METHODS FOR CSS ARE DEVELOPED.

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FIGURE B-2. Flow Diagram CSS-1--Interim Management.

Technical Issue DST-2

INTERIM MANAGEMENT

Statement of Issue

The technical issue is: On the basis that upgrades in procedures used for interim management of DST wastes are warranted, what are such upgrades and what technology must be established to make upgrades to the management system?

Surveillance and other systems currently in place have been designed to adequately protect personnel and the environment during interim storage of wastes in DSTs. Several upgrades in the procedures used to manage DST wastes have been identified. Such modifications will enhance safe containment of liquids and solids in the DSTs. This issue addresses the technical work which must be completed to accomplish currently planned upgrades and to establish the need for and type of any additional interim management system upgrades.

Scope

Carbon steel double-shell waste tanks are used to store a variety of waste liquids and slurries. The integrity of these tanks for containment of waste while final disposal methods are being developed and implemented must be evaluated. Corrosion data must be provided to define system limitations and storage temperatures to assure that an average corrosion rate of 1 mil/yr will not be exceeded over a 50-year storage period.

A system for monitoring the configuration and integrity of the double-shell tanks and for performing routine inspections is required. An accurate record of the design, location, condition, and inventories of the waste storage facilities should be maintained.

Recent occurrences of "slurry growth" in double-shell tanks that involve significant increases in the volume of slurry, accompanied by the generation of gases, have been noted.

Technology for avoiding commingling of waste types should be developed to prevent contamination of low-level liquid waste with more hazardous waste. Such contamination would increase disposal costs.

Technology for improving ongoing waste management procedures and practices should be developed to provide economy in operations and for evaluating effects of changes in waste stream chemical and physical properties. These later variations may occur as the result of changes in chemical processing and other waste management operational practices. Ongoing DST operations need to be continuously evaluated to ensure consistency with long-term disposal plans.

Status

Several double-shell tank surveillance and inspection systems are presently in place including leak detection devices in the annulus, liquid level indicators, leak detection pits, and exhaust system analyzers. A camera system with limited visual range is presently in place. A more flexible system for annulus visual imagery is scheduled for installation in FY 1985.

Waste volume projections are done on an annual basis to optimize usage of DSTs and to define the need for additional tanks. A computer model is being considered to ensure practicability of waste volume projection scenarios. Projections include developing and refining models required to accurately estimate parameters associated with waste handling and processing.

A waste tank configuration control system to ensure an accurate record of design, location, condition, and inventories of double-shell tanks has been initiated. The orderly evaluation and integration of new data into the data base management system is required.

Corrosion rate experiments for double-shell slurry, Hanford Facility wastes and future PUREX process wastes are ongoing at PNL. Initial results for double-shell slurry have been obtained (Divine, et al., 1983).

Initial laboratory work attributed the "slurry growth" phenomenon to partial decomposition of HEDTA. Additional laboratory studies of this phenomenon are underway.

A multiphase literature search was completed in FY 1984 to address the potential for exothermic reactions in double-shell tanks. It was concluded that under the alkaline conditions which prevail in wastes, organic complexants are stable toward potential exothermic reactions and, therefore, do not pose any recognized safety hazards.

Tasks to Close the Issue

The following tasks close the issue of safe interim management of DST waste:

DST-2.1 Establish corrosion data and mechanisms

Determine corrosion data and mechanisms for existing and future wastes in double-shell storage tanks. ($875,000)

DST-2.2 Implement DST annulus inspection system

Complete implementation of a flexible DST annulus inspection system. ($290,000)

DST-2.3 Provide technical support to tank farm management

Provide technical support to ongoing tank farm operations. Technology for preventing commingling of waste types should be developed as part of this task. ($450,000)

DST-2.4 Establish response to DST failure

Complete engineering studies to determine appropriate response to DST failure including evaluation of failure mode, response time, recovery, etc. ($75,000)

DST-2.5 Implement data management system

Demonstrate and update system to manage data related to waste tank inventories, and the design, location and condition of DSTs. This should be part of an overall system to manage data related to all waste management storage tanks and sites. ($290,000)

DST-2.6 Evaluate potential for unsafe exothermic reactions (Completed)

Perform literature, laboratory, and engineering studies to establish the potential for and impact of exothermic reactions in DSTs containing complexed wastes. (Completed in FY 1984).

DST-2.7 Determine slurry growth mechanisms

Perform laboratory and engineering studies to determine mechanisms and reactions in order to predict "slurry growth." ($100,000)

DST-2.8 Update data system as required

Provide additional data management upgrades as dictated by technology advances or data management requirements during the interim management period for DSTs. ($100,000)

DST-2.9 Determine corrective action for exothermic reactions (Completed)

Perform engineering studies to develop methods of preventing or mitigating the effects of exothermic reactions in DSTs. (Completed in FY 1984)

DST-2.10 Develop satisfactory method for controlling slurry growth

Perform laboratory and engineering studies to develop methods to predict, prevent, or control slurry growth phenomena. ($110,000)

DST-2.11 Develop adequate agitation method for grout feed tanks

Grout feed tanks will contain a relatively viscous slurry which must be kept in suspension during grouting. Evaluate alternatives and select method for agitation of waste in grout feed tanks. ($250,000)

DST-2.12 Waste volume projections

Develop computer models and other tools to accurately forecast volumes of wastes which need to be stored in double-shell tanks. ($200,000)

DST-2.13 Determine waste segregation requirements

Determine requirements for segregation of 200 E and 200 W Area complexed and noncomplexed wastes. ($1,000,000)

Flow Diagram

Figure B-3 illustrates the logical order of performing the tasks required to close the interim management technical issue for DST wastes.

Costs to Close the Issue

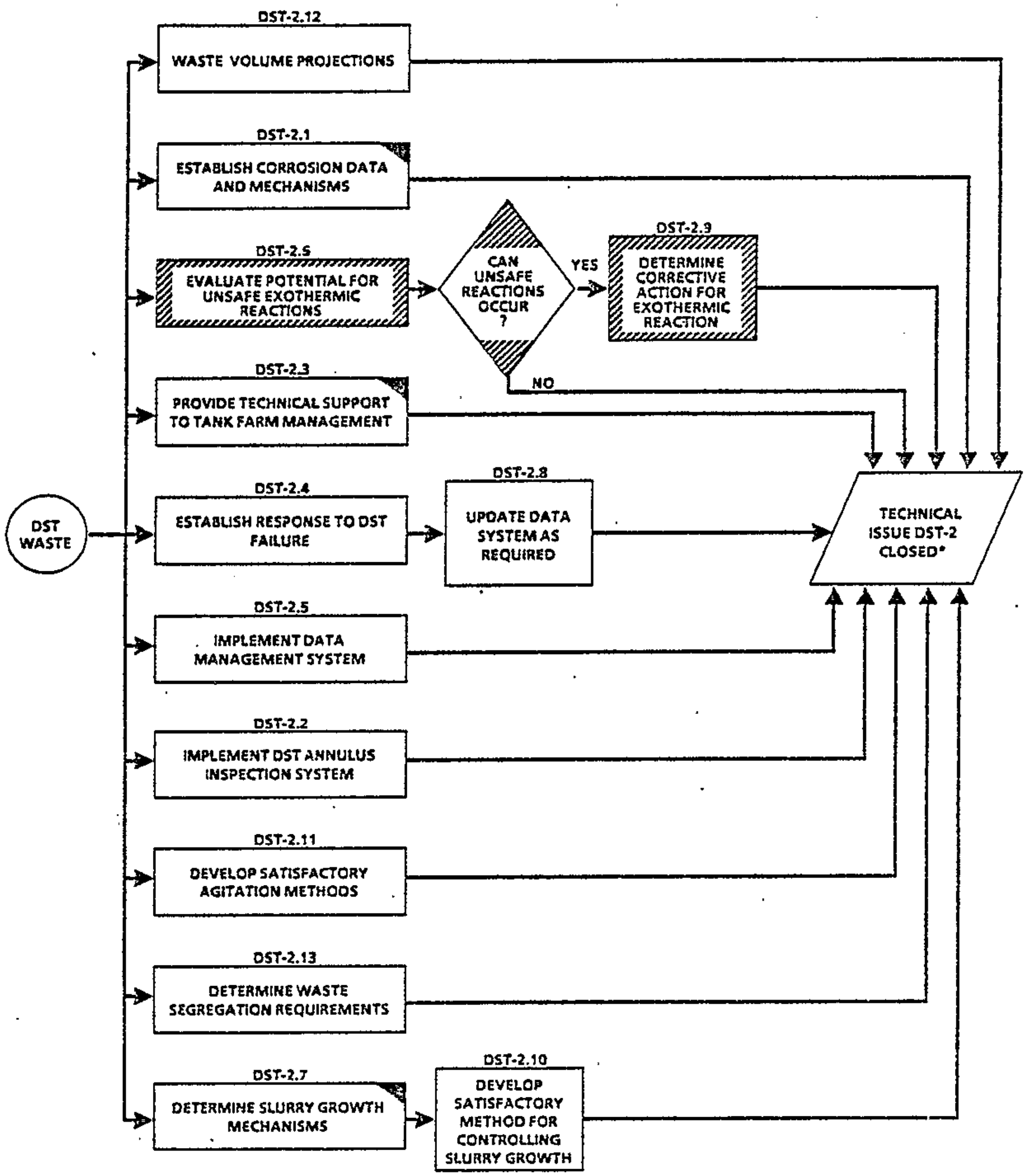
Manpower: $2,540,000
Materials: $100,000

Key Technical Decisions

No key technical decisions were identified as being required to close the issue of interim management of DST wastes.

Bibliography

Divine, J. R., M. W. Bowen, S. A. McPartland, R. P. Elmore, and D. W. Engel (1983), Program Report--Double-Shell Slurry Low Temperature Corrosion Test, PNL-4727, Pacific Northwest Laboratory, Richland, Washington.



*TECHNOLOGY FOR SAFE INTERIM MANAGEMENT AVAILABLE FOR IMPLEMENTATION.

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FIGURE B-3. Flow Diagram DST-2--Interim Management.

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